Vol. XLIII SEPTEMBER, 1959 No. 4

THE PHILIPPINE AGRICULTURIST

JOURNAL OF THE COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
University of the Philippines

CONTENTS

Exploratory Goat Dairying With Native and Grade Goats ..... *L. L. Clamohoy, V. G. Argañosa, and O. A. Palad* 243

The Effect of Some Newer Herbicides as Pre-Emergence Spray ..... *Marcos R. Vega and Pedro A. Llena* 250

Performance of Yellow-Endosperm Synthetic Corn Varieties ..... *I. S. Santos, F. A. Bernardo, and N. Marcos-Tepora* 260

Cercospora Leaf Spot of Sorghum . . *Florendo C. Quebral and Lucio N. Gibe* 271

Effects of Pump Irrigation on Farm Organization, Operation, and Income of Rice Farms in Sto. Domingo and La Purisima, Nabua, Camarines Sur ..... *Jesus C. Sta. Iglesia and Jose M. Lawas* 281

Development of Improved Merchandising Practices for Vegetables . . . *Vicente U. Quintana* 301

NOTES:

1. Spore Trapping Experiments With *Alternaria Porri* (Ellis) Cif. and *Erysiphe Polygoni* DC. ..... *R. V. Alicbusan, L. A. Schafer, and B. A. Revilla* 310

2. Cytology of Philippine Plants 1. *Averrhoa Bilimbi* Linn. . . . *Dolores A. Ramirez* 314

Paul Work 318

UNIVERSITY OF THE PHILIPPINES PUBLICATIONS SERIES A
Published at College, Laguna

NSP
RAM
MM
COMMONWEALTH MYCOLOGICAL INSTITUTE
13 JAN 1960

The Philippine Agriculturist

Journal of the College of Agriculture and Central Experiment Station
University of the Philippines

EDITORIAL STAFF

JOSE R. VELASCO, Editor
JOVITA F. VENTURA, Acting Associate Editor
JOSÉ M. CAPINPIN, Business Manager
GETULIO B. VIADO, Animal Sciences
NICOLAS L. GALVEZ, Physical Sciences
DIOSCORO L. UMALI, Plant Sciences
BASILIO N. DE LOS REYES, Social Sciences
AMADOR D. YÑIGUEZ, Statistics

ADMINISTRATIVE STAFF

LEOPOLDO B. UICHANCO ..... Dean
FRANCISCO O. SANTOS ..... Assistant Dean
JOSE M. CAPINPIN ..... Head, Department of Agricultural Botany
LEOPOLDO J. VILLANUEVA ..... Acting Head, Department of Agricultural Chemistry
PEDRO R. SANDOVAL ..... In Charge, Department of Agricultural Economics
MARTIN V. JARMIN ..... Acting Head, Department of Agricultural Education
ALEJANDRO B. CATAMBAY ..... Head, Department of Agricultural Engineering
VALERIANO C. CALMA ..... Head, Department of Agronomy
AMADO C. CAMPOS ..... Acting Head, Department of Animal Husbandry
SILVERIO M. CENDAÑA ..... Head, Department of Entomology
NENA R. BUSTRILLOS ..... In Charge, Department of Home Technology
EDELWINA C. LEGASPI ..... Head, Department of Languages
VICTORIA M. ELA ..... Acting Head, Department of Plant Pathology
NICOLAS L. GALVEZ ..... Head, Department of Soils

THE PHILIPPINE AGRICULTURIST is published monthly except in April and May by the College of Agriculture and Central Experiment Station, University of the Philippines, College, Laguna. The subscription price is ₱6.00 a year in the Philippines and $4.00 (U.S. currency) elsewhere; the price of single copies, ₱0.75 in the Philippines and $0.50 elsewhere.

Authors of articles appearing in THE PHILIPPINE AGRICULTURIST are severally responsible for the opinions expressed therein.

Publications sent in exchange for THE PHILIPPINE AGRICULTURIST should be addressed to the Library of the College of Agriculture and Central Experiment Station, University of the Philippines.

Entered at the Post Office at College, Laguna, Philippines, as second-class mail matter.

EXPLORATORY GOAT DAIRYING WITH NATIVE AND GRADE GOATS [1]

L. L. Clamohoy, V. G. Argañosa and O. A. Palad [2]

Seventeen does of the College herd were used in this study. Of these, 6 were Philippine goats, 5 one-half Philippine goat and one-half Toggenburg, 1 one-half Philippine goat and one-half French Alpine, and 5 does of mixed blood composition. It has been found that the average milk production of the grades which is 109.12 ± 25.51 kg. is higher than the Philippine goats which is 66.33 ± 17.61 kg.

The raising of dairy goats is a promising dairy industry in the Philippines. The people have found its varied uses. Goat's milk is a reliable source of nourishment for nursing infants whenever fresh cow's milk or canned milk is not available. A most striking instance is that during the Japanese occupation of the Philippines, the goats saved the lives of many babies, who otherwise would have perished.

Aside from milk, there are numerous by-products obtainable from dairy goats among them chevon, breeding goats, leather, and manure. Many owners of coconut groves in Laguna raise goats also because these animals keep down the underbrush and enrich the soil.[3]

This study was conducted in the Department of Animal Husbandry, College of Agriculture, U.P., from September, 1956 to August, 1958, to help solve some of the problems that may arise in any work on goat dairying.

MATERIALS AND METHODS

Seventeen does of the College herd were used in this study. Six of the animals were Philippine goats, 5 one-half Pihlippine goat and one-half Toggenburg, one one-half Philippine goat and one-half French Alpine, and 5 does of mixed blood composition. The herd was driven out into the pasture in the morning after milking and

[1] Central Experiment Station Contribution No. 2009. Research Project No. 977.

[2] The authors are grateful to former assistant instructors J. C. Madamba and A. S. Achacoso for their help in conducting this study.

[3] Notes on goat raising, *Sunday Times Magazine*, Jan. 22, 1956.

brought back to the milking barn in the afternoon. After the afternoon milking, the does were driven into an inclosure to graze till late in the evening and before milking the following morning. This inclosure was adjacent to their shelter where they stayed during the night. All does about to kid and dams with newly born kids were kept in this pasture for safety. During rainy days, the animals were given soilage in the barn.

The kids were allowed to stay with their respective dams for the first three to five days for colostrum feeding, depending upon the vigor of the young. After this period, the kids were separated from their mothers and were raised artificially.

The milk feeding schedule of the young is shown in table 1.

TABLE 1.—*Milk feeding schedule*

AGE	AMOUNT	FREQUENCY		TOTAL AMOUNT PER WEEK
		Per day	Per week	
(day)	*(gram)*		*with the mothers*	*(gram)*
3 to 5				
4 to 10	100	3X	21X	2,100
11 to 17	150	3X	21X	3,150
18 to 24	150	3X	21X	3,150
25 to 31	200	2X	14X	2,800
32 to 38	150	2X	14X	2,100
39 to 45	150	2X	14X	2,100
46 to 52	200	X	7X	1,400
53 to 59	200	X	6X	1,200
60 to 66	200	X	5X	1,000
67 to 73	200	X	3X	600
				Total—19,600

Within the 70-day period a kid was given 19,600 grams of milk. Milk feeding was extended up to 100 days for weaker kids. Soilage was given *ad libitum* when the kids started to nibble on grass. Water was made available to them at all times. The kids were confined and not allowed to graze in the pasture until they were five to six months old to protect them from heavy parasite infestation. At 6 weeks of age, phenothiazine was administered to them at the rate of 0.1 per cent of their body weight.

Milking was done regularly at 7:00 o'clock in the morning and at 3:00 o'clock in the afternoon. The does were dried gradually

when they started to give less than 50 grams of milk a day. At the time of milking all strangers, animals and people alike, were not allowed to go near the milking area to prevent the milking animals from getting excited.

All milking does were assigned permanently to individual milking stanchion and were fed concentrate during the time of milking. The amount of concentrate given was based on one per cent of their body weight adjusted weekly. Two concentrate mixtures had been tried for milk production of dairy goats as shown in table 2.

TABLE 2.—*Rations for the dairy goats*

INGREDIENTS	RATION 1	RATION 2
	kgm.	*kgm.*
Ground Yellow Corn	55.0	33.0
Fine Rice Bran	22.5	33.0
Copra Meal	10.0	33.0
Fish Meal	7.5	——
Soy Bean Oil Meal	5.0	——
Common Table Salt	1.0	1.0
"Binlid"	100.0	——
TOTAL	201.0	100.0

The weight of individual milk production was taken during milking time. The amount of concentrate left in the feeding trough was weighed once a week and subtracted from the amount given. The difference represented the amount consumed by the animals.

RESULTS AND DISCUSSION

Age and lactation period. The age of the nine does ranged from 1 year and 8 months to 5 years and 7 months at the start of the experiment. When the youngest animal gave birth for the first time, two animals were already on their sixth lactation period.

Lactation days. As shown in table 3, the average lactation period of the Philippine goat was 187.33±16.51 days; the grades, 216.33±27.09 days; and the mix-blooded does, 281.20±36.27 days. The range of the lactation period for all animals was 117 to 354 days or a mean of 225.17±17.29 days. This was much shorter than that

reported by Villegas [4] for 6 Anglo-Nubian grade does, which was 294 days on the average during one lactation period.

During the second milking trial, the lactation period ranged from 101 to 259 days, or a mean of 169.50±16.29 days. The shorter lactation period in the second trial could be attributed to immediate breeding of the does as soon as first heat after kidding was observed.

Milk production. The average milk production of the Philippine goat was 66.33±17.61 kilograms during the first trial. The biggest animal gave as much as 146.98 kilograms of milk during 243 days of lactation. The lowest production among the native goats was 19.11 kilograms within the 117 days lactation period. Among the grades, the highest production was 196.88 kilograms and the lowest, 51.23 kilograms. The average production of the grades was 109.12 ± 25.51 kilograms. The mix-blooded animals gave an average of 91.27±18.51 kilograms. All animals yielded on the average 88.76±12.31 kilograms of milk.

In the second trial, where selected higher producers were used, the amount of milk produced ranged from 27.99 kilograms for the Philippine goat to 162.91 kg. for the Grade Philippine-Toggenburg. The average milk production was practically the same as the first trial despite the fact that its average lactation period was shorter.

The average daily milk production of all animals ranged from 0.16 to 1.01 kilograms, or an average of 0.5±0.05 kilograms for the first lactation period; for the second trial, the average daily milk production was 0.49±0.06 kilograms.

The amount of milk drawn in the morning was more than twice the amount of milk drawn in the afternoon. This was attributed to the difference in the intervals between milkings.

Amount and cost of concentrate consumed. The efforts made to let the kids take in concentrate at the earliest possible age were of no avail. Kids raised artificially will eat concentrate only when they are turned to the herd.

The average amount of concentrate consumed by the Philippine goats during the first trials was 35.22±7.37 kilograms; the grades, 47.97±6.36 kilograms; and the mix-blooded animals, 54.99±5.80 kilograms; the average for all the animals being

[4] V. Villegas, *U.P. Coll. Agric. Sta. Cir.*, 22 (1932).

TABLE 3.—*Summary of results*

	FIRST LACTATION				SECOND LACTATION			
	A[1]	B	C	Pooled average	A	D	C	Pooled average
Number of animals used	6	6	5	17	4	3	4	11
Average weight of animal, kg.	24.63 ± 1.85	27.10 ± 3.08	24.64 ± 1.51	25.51 ± 1.30	26.50 ± 2.20	31.50 ± 4.72	25.90 ± 1.02	27.60 ± 1.56
Average milk production, kg.	66.33 ± 17.61	109.12 ± 25.51	91.27 ± 18.51	88.76 ± 12.31	43.00 ± 13.82	138.90 ± 20.90	95.70 ± 19.00	88.30 ± 11.82
Average concentrate consumption, kg.	35.22 ± 7.37	47.97 ± 6.36	54.99 ± 5.80	45.53 ± 4.15	22.20 ± 4.58	65.60 ± 4.57	43.50 ± 5.70	41.80 ± 5.23
Average cost of concentrate to produce a kg. of milk, pesos	0.11 ± 0.02	0.11 ± 0.02	0.13 ± 0.02	0.12 ± 0.01	0.12 ± 0.03	0.11 ± 0.01	0.10 ± 0.01	0.11 ± 0.01
Average lactation period, days	187.33 ± 16.51	216.33 ± 27.09	281.20 ± 36.27	225.17 ± 17.29	115.80 ± 7.33	215.70 ± 22.15	188.50 ± 7.30	169.50 ± 16.29
Average daily milk production, kg.	0.33 ± 0.02	0.53 ± 0.01	0.31 ± 0.02	0.04 ± 0.05	0.35 ± 0.09	0.68 ± 0.21	0.50 ± 0.05	0.49 ± 0.06

[1] GROUP	NO. OF GOATS	"BLOOD" COMPOSITION
A	6	100% Philippine goat
B	5	50–50 Philippine-Toggenburg
	1	50–50 Philippine-French Alpine
C	5	undetermined mixture
D	3	50–50 Philippine-Toggenburg

45.53±4.13 kilograms. The average cost of concentrate to produce a kilogram of milk was ₱0.12.

During the second milking period, all animals consumed on the average 41.80±5.23 kilograms of concentrate. The average cost of concentrate to produce a kilogram of milk was ₱0.11.

Milk for human consumption. The average kid to a doe was 1.5. Based on the feeding schedule, the total amount of milk consumed by the kids was 823.2 kilograms for the two milking experiments. In addition, an allowance of 10.0 per cent extra milk was given to weak kids, giving a total of approximately 900.0 kilograms of milk, or 36.29 per cent of the total production. Thus, 63.71 per cent or 1580 kilograms were made available for human consumption. If the milk were sold at ₱0.75 [5] a kilogram, the gross income would amount to ₱1,185.00. The total cost of concentrate consumed by the animals was ₱258.01; thus, the return above concentrate cost would be ₱926.99, or ₱33.12 on the average per animal in one lactation period.

Trials were conducted also on the advisability of drinking goat's milk after milking without undergoing pasteurization. Before milking, the teats of the does were wiped with wet cloth to remove the adhering dirt and loose hair. Then the milk was strained with a piece of clean cheese cloth. While still warm the milk was given in 400-ml. beaker to six different individuals varying in ages from 18 to 49 years. The trials were repeated for a period of one month. None among those who drank the milk reported having had diarrhea or any stomach trouble which could be ascribe to the milk.

RECOMMENDATIONS

1. Does producing less than 75 kilograms of milk in one lactation period should not be used for commercial goat dairying. They may be used, however, as a diary goat on an ordinary farmer's type of dairying.

2. Does producing less than 25 kilograms of milk in one lactation period should not be raised as dairy goats. They may be raised for meat only. If such does will be milked on an ordinary farmer's type of dairying, the kids will not receive enough milk for their growth and development.

[5] Current price of milk in the College of Agriculture, U.P.

3. Breeding of high-producing animals should be well-regulated.

4. Fresh soilage and concentrate are to be given every day, for goats do not eat leftovers.

5. Punctuality and regularity in milking, feeding, and herding animals to the pastures and back will give better results.

6. Goats producing 100 grams of milk or less in one day should be dried gradually to prepare them for the next lactation period.

7. Goats that are raised artificially hesitate to go with the herd at weaning for these animals lack gregariousness. Raising kids in an inclosure near the barn or near their dams after the kids have been separated for about one month will help solve the problem.

8. Placing one or two wether goats with the group of artificially raised kids will induce the kids to take in concentrate as early as possible.

THE EFFECT OF SOME NEWER HERBICIDES AS PRE-EMERGENCE SPRAY[1]

MARCOS R. VEGA and PEDRO A. LLENA

Some newer herbicides were tried as pre-emergence spray for weed control in upland rice. The herbicides were: Emid, Neburon, EPTC, Benzac A, and ACP L-688. Of these herbicides, Neburon and ACP L-688 are worth further investigations.

There is no doubt that 2,4-D and its relatives can control most of the broad-leaved weeds in upland rice; that is, weeds like *Ipomoea triloba* L., *Portulaca oleracea* L., *Colopogonium muconoides* Desv., *Amaranthus spinosus* L., and others. But a problem arises because as a consequence of eliminating the broad-leaved weeds, germination and growth of grass weeds are favored. There is no doubt also that 2,4-D, at concentrations tolerated by rice, is of very little help in controlling grass weeds.

An ideal way of controlling weeds, especially grass weeds which are more difficult to control, would be to prevent or delay long enough their germination. This could be accomplished with the use of pre-emergence sprays. Some herbicides (Premerge, LV-4, and CMU) have been tried for pre-emergence spraying in upland rice. None of these herbicides proved useful.

This study was conducted to find out if a suitable herbicide for pre-emergence spray can be found among some newer herbicides. The study was conducted from May to November, 1958 at the U.P. College of Agriculture and Central Experiment Station.

MATERIALS AND METHODS

The herbicides used in the study were:

1) Emid—2,4 dichlorophenoxyacetamide
2) Neburon—1,n-butyl-3(3,4-dichlorophenyl) 1-methyl urea
3) EPTC—Ethyl-N, N-di-n-propyl-thiolcarbamate
4) Benzac 103 A-mixed polychlorinated benzoic acids:

[1] Central Experiment Station Contribution No. 2010 Part of Project No. 1182, financed by RA 1606.

a) 2,3,5-trichlorobenzoic acid —16.3%
b) 2,3,5-trichlobenzoic acid — 7.8%
c) 2,3,5,6-tetrachlorobenzoic acid —36.4%
d) other isomers —39.5%

5) ACP L-688-Diethanoamine salt of 2,4-dichlorophenoxy-propionic acid.[2]

The herbicides were applied as pre-emergence spray at rates indicated in table 1. There were two groups of treatments made,

TABLE 1.—*Summary of Operations*

TREATMENT NUMBER	PRE-EMERGENCE TREATMENT—MAY 23	POST-EMERGENCE TREATMENTS	
		Operation	Date
1	Emid–4.49 kgs./Ha.	a) handweeding	June 20
2	Neburon–4.49 kgs./Ha.	a) handweeding	June 20
3	EPTC–4.49 kgs./Ha.	a) handweeding	June 20
4	Benzac 103A–1.12 kgs./Ha.	a) handweeding	June 20 June 20
5	ACP L-688–2.25 kgs./Ha.	a) handweeding	June 20
6	Emid–4.49 kgs./Ha.	a) spraying with 0.56 kg./Ha. kuron b) handweeding	June 25 July 3
7	Neburon–4.49 kgs./Ha.	a) spraying with 0.56 kg./Ha. kuron	June 25
8	EPTC–4.49 kgs./Ha.	a) spraying with 0.84 kg./Ha. kuron b) handweeding	June 25 July 3
9	Benzac 103A–1.12 kgs./Ha.	a) spraying with 0.89 kg./Ha. kuron b) handweeding	June 25 July 3
10	ACP L-688–2.25 kgs./Ha.	a) spraying with 0.84 kg./Ha. kuron	June 25
11	Check (Untreated)	a) handweeding	June 17

both groups using the same herbicides applied at the same rates. One group (treatment nos. 1 to 5) was handweeded once in addition to the pre-emergence spray and the other group (treatment nos. 6 to 10) was sprayed with Kuron (2,4,5-trichlorophenoxypropionic acid) and handweeded in addition to the pre-emergence spray. In this latter group, one treatment (treatment no. 7) was no longer handweeded as it was not necessary to do so after spraying the Kuron. Check plots which were unsprayed but handweeded were provided for in treatment no. 11.

[2] The herbicides were obtained as free samples; Emid, Benzac 103A and ACP L-688 from AMCHEM Products, Inc., Ambler, Pa.; EPTC from Stauffer Chem. Co. Chauncy, New York; and Neburon from E. I. de Nemours and Co., Wilmington, Delaware.

Upland rice, variety Azucena, was planted in 1.5 × 10 meter plots on May 22, 1958. The pre-emergence sprays were applied on

Fig. 1. Rice planted on May 22, 1958; herbicides applied on May 23; and photographed June 11.

a) The appearance of check (untreated) plots.
b) Plot treated with 4.49 kgs. of Neburon per hectare.
c) Plot treated with 4.49 kgs. of Emid per hectare.
d) Plot treated with 4.49 kgs. of EPTC per hectare.
e) Plot treated with 1.12 kgs. of Benzac 103A per hectare.
f) Plot treated with 2.24 kgs. of ACD L-688 per hectare.

May 23. Each treatment was replicated four times. Among observations taken were weed count, rice stand count, and gross morphological effects of the herbicides on the rice plants. Photographs were likewise taken whenever deemed necessary. The grains were harvested at maturity; they were threshed, dried, and cleaned of empty grains and other foreign materials. The yield from each treatment was then determined and the yield data analyzed statistically.

RESULTS AND DISCUSSION

Emid—Emid drastically reduced the stand of rice (fig. 1c). The newly germinated seedlings had elongated coleoptiles and were chlorotic; added to this condition was the complete absence of roots in some. These are reminiscent of 2,4-D effect on the germination of rice. This condition may be expected since Emid is closely related to 2,4-D. Most of the affected seedlings did not live long so that when a stand count was taken on June 4, the number of rice plants per foot distance in the Emid treated plants were just about ¼ the number in the untreated plots. By the time the second stand count was made, there was a slight increase in number which indicated delayed germination of some seeds. Even then, the plants were still less than half the number in the untreated plots (table 4, columns 2 and 3). The growth of the surviving rice plants was also adversely affected when height of plants was used as the criterion of growth (table 4, columns 4 and 5).

Emid, however, greatly reduced weed germination (table 2).

TABLE 2.—*The effect of the different herbicides on the germination of weeds.*

TREATMENT	NUMBER PER 625 SQ. CM.			
	June 4		June 16	
	Total No. of weeds	No. of grass weeds	Total No. of weeds	No. of grass weeds
Emid	0.6	0.06	5.8	2.75
Neburon	1.1	0.00	4.9	2.37
EPTC	0.9	0.06	8.9	2.37
Benzac 103-A	1.0	0.00	24.1	11.56
ACP L-688	0.7	0.12	13.5	6.81
Check	1.2	0.25	33.8	17.75

Plots treated: May 23

Data for each treated plot are averages of 16 observations; in the check plot they are only averages of 8 observations.

No weed count is presented after June 16 because plots were either sprayed with kuron or handweeded.

On the last count, the weed population in Emid treated plots was just about 1/6 the number in untreated plots and even the grass weeds were substantially controlled. Because of this, the number of man-minutes to handweed the Emid treated plots was reduced to approximately ¼ the requirement to handweed the untreated plots (table 3).

TABLE 3.—*Man-minutes to handweed treatment numbers 1 to 5 and 11*

TREATMENT	REPLICATIONS				TOTAL	AVERAGE
	I	II	III	IV		
1 Emid	27	45	34	45	151	37.75
2 Neburon	25	30	19	38	112	28.00
3 EPTC	31	35	40	31	131	34.25
4 Benzac 103-A	54	50	67	95	266	66.50
5 ACP L-688	63	45	40	71	219	54.75
11 Check	80	74	40	60	254	63.50

Check plots weeded on June 17; the rest on June 20

In treatment no. 6 where a Kuron spray was combined with Emid, only 0.56 kg. per hectare (½ pound per acre) was sprayed as contrasted with other plots where 0.84 kg. per hectare or ¾ pound per acre of Kuron was sprayed. The decision to use 0.56 kg. or 0.84 kg. of Kuron per hectare was based on weed population. In addition to the Kuron spray, treatment no. 6 required 53 man-minutes to rout the weeds, especially the grasses, that survived the spray. The yields obtained from the Emid treated plots (treatment nos. 1 and 6) were lowest and were significantly lower than the check (treatment no. 11).

Neburon—Neburon did not affect the germination of rice (fig. 1b). On June 4, rice plants from the Neburon and untreated plots were comparable, having about three leaves per plant. There was a slight reduction in the number of seedlings caused by Neburon. When the first count was made on June 4, the check plots had 29.1 rice plants per foot, while Neburon treated plots had only 25.6. This number was further reduced to 22.6 per foot by the time the second count was made on June 16 (table 4). This indicates that Neburon has delayed effects. This effect of Neburon, that is, allowing the plants to germinate but after apparently absorbing the herbicide, injury and consequently death follows, is very much like the effects of CMU (3-parachlorophenyl, 1,1-dimethyl urea). That is because they are closely related chemicals.

This slight reduction in the stand of rice did not adversely affect the yield of rice. The yield of treatment no. 2 (Neburon plus

handweeding) was even higher than the yield of check plots (treatment no. 11) ; while treatment no. 7 had slightly lower yield than the check, the reduction is not however significant.

TABLE 4.—*The effect of the different herbicides on the germination and growth of rice.*

TREATMENT	NUMBER OF PLANTS PER FOOT DISTANCE		AVERAGE HEIGHT IN CENTIMETERS	
	June 4	June 16	June 4	June 16
Emid	7.8	11.70	6.4	13.70
Neburon	25.6	22.62	19.35	33.18
EPTC	11.4	9.87	10.54	25.19
Benzac 103-A	21.93	22.00	0.08	21.89
ACP L-688	21.62	23.50	5.95	15.27
Check	29.12	29.00	19.88	33.36

Neburon effectively controlled the weeds. Even at the last counting (June 16), the weed population in the Neburon treated plots was very much lower than the check plots, being 4.9 and 33.8 sq. cm. respectively. The grass weeds were equally affected: grass weed population being 2.37 per 625 sq. cm. in Neburon treated plots as compared to 17.8 in check plots (table 2). It required the lowest number of man-minutes to handweed the Neburon treated plots, being 28.0 as compared to 63.5 in the check plots. Only 0.56 kg. per hectare of Kuron was needed for controlling weeds in treatment no. 7 (Neburon plus Kuron). Furthermore, unlike the other chemically treated plots, the Neburon treated plots did not require further handweeding (table 5). This is due, among other things, to the relatively few grass weeds present in these plots.

TABLE 5.—*Man-minutes to handweed*[a] *grass weeds that survived the kuron treatment*

TREATMENT	REPLICATIONS					
	I	II	III	IV	Total	
Emid + 0.56 kg./Ha. kuron	40	59	60		159	53.00
Neburon + 0.56 kg./Ha. kuron	(The plots did not need any further weeding)					
EPTC + 0.84 kg./Ha. kuron	37	40	40	49	169	42.25
Benzac 103-A + 0.84 kg./Ha. kuron	62	95	33	50	240	60.00
ACP L-688 + 0.84 kg./Ha. kuron	53	35	51	40	179	44.75

[a] Kuron sprayed on June 25; plots handweeded on July 3 and 7.

The species that survived the Neburon treatments or those that germinated after the Neburon level in the soil had apparently gone down below toxic levels, were readily controlled by Kuron. At close-in time, the appearance of Neburon treated plants were comparable to that of the check plants (fig. 2a & b). Of these herbicides, Neburon showed the brightest prospects as a pre-emergence herbicide for upland rice. Subsequent laboratory experiments however showed that Neburon may not be too safe to use under certain conditions. One factor that greatly influences the effects of Neburon is soil moisture. The influence of water and a few other factors on the effectiveness of Neburon is the subject of present studies in the department.

Fig. 2.—Photographed July 3, 1958, 42 days after planting. (a) Plot treated with 4.49 kgs. neburon + 0.56 kg. kuron per hectare. (b) Untreated (handweeded once) plot.

EPTC—EPTC also drastically reduced the stand of rice (fig. 1d). There was only 11.4 plants per foot distance in EPTC treated plots as compared to 29.1 in the check plots. This number (11.4) was further reduced to 9.9 by the time the second count was made (table 4). Those that survived the treatment were however apparently normal, being as green as the untreated plants. This could also be deduced from the growth rate of the plants. In EPTC treated plants, the increase in height from June 4 to June 16 was 14.7 cm.,

the increase during the same period in untreated plants was 13.4 cm. (table 4). This reduced stand of rice plants was reflected in reduced yield of grains. The reduction was, however, not significant (table 6).

TABLE 6.—*The effect of the different treatments on the yield of grains in cavans per hectare*

TREATMENT	REPLICATIONS				AVERAGE
	I	II	III	IV	
1. Emid + handweeding	25.74	21.46	17.03	2.75	16.75
2. Neburon + handweeding	54.02	54.70	61.84	50.17	55.18
3. EPTC + handweeding	44.18	25.46	32.88	47.76	37.57
4. Benzac 103-A + handweeding	56.59	52.11	57.39	58.36	56.11
5. ACP L-688 + handweeding	61.18	24.00	32.06	55.15	43.10
6. Emid + 0.56 kg./Ha. kuron + handweeding	39.35	15.02	15.73	23.04	23.29
7. Neburon + 0.56 kg./Ha. kuron	42.52	51.52	49.20	42.76	46.50
8. EPTC + 0.84 kg./Ha. kuron + handweeding	44.65	34.90	43.20	45.66	42.10
9. Benzac 103-A + 0.84 kg./Ha. kuron + handweeding	37.58	28.19	38.33	23.63	31.93
10. ACP L-688 + 0.84 kg./Ha. kuron + handweeding	46.86	41.91	37.34	32.66	39.69
11. Check (handweeded)	54.05	48.67	54.24	56.05	51.00

H.S.D. 5% = 19.86

EPTC was quite effective in controlling the weeds. At the last count, EPTC treated plots had 8.9 weeds per 625 sq. cm. as compared to 33.8 weeds in untreated plots. Even the grass weeds were adversely affected (table 2). In treatment no. 3 (EPTC plus handweeding), only 34.4 man-minutes was required to handweed a plot as contrasted with 63.5 man-minutes in an untreated plot. In treatment no. 8 where 0.84 kg. per hectare of Kuron was combined with EPTC, 42.25 man-minutes was required to rout the weeds that survived the Kuron spray. The number of man-minutes to handweed the plots treated with a pre-emergence herbicide plus Kuron spraying is indicative of the number of Kuron-resistant weed species that survived the pre-emergence treatment or germinated after the effects of pre-emergence treatment was gone.

BENZAC 130 A—Benzac 103 A delayed the germination of rice with very little reduction in stand (table 4 and fig. 1e). Most of the seedlings were chlorotic as they emerged from the soil, but they recovered from this effect. Apparently, the effect of Benzac 103 A was just a delay in germination for growth was unaffected. The growth increment of Benzac 103 A treated plants during the period from June 4 to June 16 was 21.8 cm. During this same period the

increment in untreated plants was 13.4 cm. The yield of plots treated with Benzac 103 A plus handweeding (treatment no. 4) was higher than the checks, but the number of man-minutes to handweed this plot was higher than that required to handweed the check plots (table 3). Where 0.84 kg. per hectare of Kuron and handweeding was combined with Benzac 103 A (treatment no. 9), the yield was quite low. This reduction was, however, not significant.

The low yield obtained in treatment no. 9 can be explained as follows: (a) Benzac 103 A delayed the germination of the weeds with very little reduction in number; (b) the grass weeds were hardly affected (table 2). This delay in the germination of weeds was not of any help because the germination of rice was likewise delayed. Thus the crop and the weeds grew hand in hand. The Kuron spray only controlled the broadleaved weeds with practically no effect on the grasses, mainly because the grasses were by this time fairly well established. Apparently, therefore, the grass weeds had exerted their ill-effects before they were weeded out on July 3.

ACP L-688—ACP L-688 just delayed the germination of both the rice and the weeds with very little reduction in number (fig. 1f). Of the herbicides tried, ACP L-688 reduced the stand of rice the least: 23.5 per foot distance as compared to 29 in the untreated plots (table 4). The delay in the germination of rice can be deduced by comparing the rice plants in fig. 1f with those in fig. 1a and by taking note of the observation regarding the heights of the rice plants (table 4, columns 4 and 5).

The germination of the weeds was apparently delayed until June 16 (or 25 days after planting). There were only 13.5 weeds per 625 sq. cm. in ACP L-688 treated plots as compared to 33.8 in untreated plots. That this was just a delay in germination and not a reduction in number can be concluded from the data on man-minutes to handweed the different treated plots (table 3). It took 54.75 man-minutes to handweed the treated plots. This number is just 8.75 man-minutes less than that required to handweed the untreated plots. In the treatment where Kuron spray was combined with ACP L-688, 0.84 kg. of Kuron per hectare was used. In addition, 44.75 man-minutes was needed to handweed the plots after the Kuron spray. This can be used as a measure of the number of Kuron-resistant weeds. ACP L-688 with Kuron did not significantly reduce the yield of rice although the yield obtained from treatment no. 10 was lower than that obtained from treatment no. 5.

CONCLUSION

The effect of the different pre-emergence herbicides on the yield of rice can be judged from the yield obtained from treatment numbers 1 to 5 as compared with the yield of treatment no. 11. In the first treatments, the plots were handweeded as soon as the weeds grew, so that whatever reduction in yield there was would be largely due to the pre-emergence treatment. This reduction in yield was mostly due to the reduction in stand of rice. A favorable effect of the herbicide on rice, however, must be accompanied by an adverse effect on the weeds especially on the grass weeds.

On these bases, Neburon has the brightest prospects among the herbicides tried. It was effective on weeds, both the broadleaved and the grass weeds, and had no adverse effects on the crop. But as was pointed out earlier, Neburon may prove disadvantageous to use under certain environmental conditions. Of the factors in the environment, soil moisture apparently has the greatest influence on the effectiveness of Neburon.

ACP L-688 is another herbicide that may prove useful in delaying the germination of weeds. It has apparently little adverse effect on rice aside from the delay in germination. If ACP L-688 could be applied after the rice plants have germinated but before most of the weeds have emerged, the germination of the weeds may be sufficiently delayed. This possibility will have to be explored.

Benzac 103 A, because it has very little effect on grass weeds, and Emid and EPTC because of their adverse effects on rice are of little help as pre-emergence herbicides.

PEFORMANCE OF YELLOW-ENDOSPERM SYNTHETIC CORN VARIETIES [1]

I. S. Santos, F. A. Bernardo and N. Marcos-Tepora

High combining inbred lines, some of which were previously extracted from College Yellow Flint and Cuban Yellow Flint varieties and others obtained from the United States and Colombia, South America were combined into 4-line, 6-line, and 8-line synthetics.

Not one of the nine synthetics outyielded significantly the College Yellow Flint variety in the two dry-season tests, although the mean yield of most synthetics was much higher in the 1956-57 planting. However, two synthetic varieties (Syn. i_1 and Syn. h_1) yielded significantly better than the College Yellow Flint variety in the 1957 wet-season performance test. The yields of these two synthetics were as high as that of Phil. Hybrid No. 1d, a double-cross hybrid recommended by the Philippine Seed Board.

There was no significant difference between the yields of the first generation synthetics and those of the second generation synthetics. Under extreme drought conditions the synthetic varieties and Philippine Hybrid 1d, 3, and 7 were no better than College Yellow Flint.

The higher cost of hybrid corn seed is usually compensated for by the increased yield of the hybrid corn when planted on good soil. In marginal areas and in places that are less accessible due to poor transportation, however, the use of hybrid corn seed may not be practical for the small increase in yield that may be obtained. In such areas, the use of synthetic varieties which yield higher than the open-pollinated varieties may prove more advisable.

Many studies on the value and use of synthetic varieties have already been done by leading corn breeders in the United States. Sprague and Jenkins (1943) [2] compared the performance of four 16-line synthetics (made by combining 16 inbreds), one 24-line synthetic, and eight 16-line multiple hybrids with the standard double crosses and open-pollinated varieties. They found that the percentage yields obtained in advanced generation synthetics as compared with those of the F_1 double crosses were 94.3 in F_2, 95.4 in F_3, and 95.1 in F_4. The average yields of the synthetic varieties closely ap-

[1] Central Experiment Station Contribution No. 2011.

[2] G. F. Sprague and M. T. Jenkins, *Jour. Amer. Soc. Agron.*, **35**, 137-147 (1943).

proximated those of the open-pollinated varieties, probably because the inbreds were not selected for combining ability. However, the yields of the F_2 and the succeeding generations were practically the same provided that no selection for specific character was practised. Theoretically, the yield in the F_2 is the yield in the succeeding generations.

Sprague and Jenkins also pointed out that four factors operate to determine the yields of advanced generation hybrids, namely, (1) number of inbred lines involved, (2) mean yield of these lines, (3) mean yield of all the possible single crosses, and (4) percentage of self-pollination.

The number of lines to be used in making a synthetic variety has been debated upon. Kinman and Sprague (1945)[3] concluded that generally the most efficient number of lines included in a synthetic variety will vary with the range of combining ability among the inbred parents. On the basis of their study, synthetic varieties involving 4 to 6 high combining line appear to be the most practical.

Hayes, Rinke, and Tsing (1944)[4] mentioned the importance of combining genetically diverse lines that are themselves adapted to the region where the synthetic will be grown.

Lonnquist (1949)[5] stated that general combining ability is very important in developing high-yielding synthetics. The importance of general combining ability in synthetics would be easy to understand if we assume that lines with high general combining ability possess many favorable dominant genes and that heterosis in yield is mostly due to the accumulation of favorable dominant growth factors at several loci.

Brieger (1950)[6] explained heterosis in maize on the basis of the "existence of loci carrying special heterotic alleles which when heterozygous increase vigor." The plants in this so-called balanced population are highly heterozygous or are kept so because of the presence of a large number of genes which have a low survival value when homozygous.

---

[3] M. L. Kinman and G. F. Sprague, *Jour. Amer. Soc. Agron.*, **37**, 341-351 (1945).

[4] H. K. Hayes, E. H. Rinke and Y. S. Tsiang, *Jour. Amer. Soc. Agron.*, **36**, 998-1000 (1944).

[5] J. H. Lonnquist, *Agron. Jour.*, **41**, 153-156 (1949).

[6] F. G. Brieger, *Genetics*, **35**, 420-445 (1950).

A relatively desirable synthetic variety was produced by utilizing eight unrelated inbreds that combined relatively well in all possible single-cross combinations (Hayes, Rinke and Tsiang (1944)[7]. It was superior to an open-pollinated variety and approached the double cross Minhybrid 403 in performance index.

Lonnquist (1949)[8] combined eight S_1 lines with high general combining ability into one synthetic and compared this with the parental variety in yield tests. The result of his study showed that it is possible to increase yields above those of open-pollinated corn by the production of synthetics.

This study was undertaken in the College of Agriculture and Central Experiment Station, College, Laguna, from November, 1956 to March, 1959, to aid in the development of high-yielding yellow-endosperm synthetics for planting in places where the use of double-cross hybrids is not advisable.

MATERIALS AND METHODS

Materials. The Division of Plant Breeding produced in the 1956 wet season the following advanced generation of multiple crosses (4-line, 6-line, 7-line and 8-line) which may be considered as synthetic varieties:

Synthetic a_1[(193 × 194)(A102 × A106)][(117 × 118)(A111 × A113)]*
Synthetic b_1[(193 × 194)(A102 × A103)][(A102 × A104)(A111 × A113)]*
Synthetic c_1[(118 × 180)(A102 × A103)][(A102 × A104)(A111 × A113)]*
Synthetic d_1[(118 × 180)(A102 × A103)][(A103 × A107)(A111 × A113)]*
Synthetic e_1[(118 × 180)(A102 × A103)][(A102 × A106)(A112 × A113)]*
Synthetic f_1[(118 × 180)(A102 × A106)][(117 × 118)(A111 × A113)]*
Synthetic g_1[(192 × A112)(A102 × A103)][(A102 × A104)(A111 × A113)]*
Synthetic h_1[(183 × A113)(A102 × A103)][(A102 × A106)(A111 × A113)]*
Synthetic i_1[(A102 × A107)(A111 × A113)]**

The symbol * is used to indicate sibbing and the subscript of letter designation show the number of sibbings done.

The first generation (sibbed only once), second generation (sibbed twice), and third generation (sibbed thrice) of these synthetic varieties were used in this experiment. The origin and a short description of the inbred lines (all yellow-endosperm) involved in these synthetic varieties are as follows:

[7] *Op. cit.*
[8] *Op. cit.*

DESIGNATION	SOURCE	PLACE OF ORIGIN	NATURE OF KERNEL
I17	F6	Florida, U. S. A.	Dent
I18	F44	" "	Flint
I80	Eto-13A-1-*-*-*	Medellin, Colombia, South America	"
I83	Eto-185-1-*-*-	" "	"
I92	Col. 1-45-2-* *	" "	"
I93	Ven. 1-1-2-*-3-*-*-*-*	" "	"
I94	Desc. 1-*-20-*-*-*	" "	Flinty dent
A102	College Yellow Flint	Philippines	
A103	" " "	"	
A104	" " "	"	
A106	" " "	"	
A107	" " "	"	
A111	Cuban Yellow Flint	Cuba	
A112	" " "	"	
A113	" " "	"	

All the inbred lines used in the synthetics have high combining ability as double crosses. Some of these double cross were found outstanding in several seasons of regional tests and are presently recommended by the Philippine Seed Board for seed production and distribution.

College Yellow Flint and Philippine Hybrid No. 1d, (A106 × A107) (A111 × A113), a widely adapted open-pollinated variety and double cross hybrid respectively, were used as checks in the performance tests of the Synthetic varieties.

Methods. Two yield tests in the dry season and another in the wet season were conducted. Two dry-season plantings were done in November, 1956 and in December, 1958. The wet-season planting was done in May, 1957.

The simple randomized block design with four replications was used for the dry season plantings. In the 1956-57 dry season planting, the first generation synthetics were compared with College Yellow and Philippine Hybrid No. 1d. Only five of the nine synthetics were further tested in the 1958-59 dry season because of limited seeds.

The split-plot randomized block design was used for the wet-season test in which the performances of the first and second generation synthetics were compared. The pedigree made up the main plots and the two synthetic generations, the sub-plots. In both yield trials each plot consisted of 4 rows, 10 meters long. The distance between rows was one meter; between hills in the row, one-half

meter. Five seeds were planted to each hill. The hills were thinned to two plants about two to three weeks after planting. Ammonium sulfate fertilizer, at the rate of 125 kilograms per hectare, was applied around the plants just after the last cultivation which was done when the plants were about one foot tall.

The date of silking of each plot was recorded when about 50 per cent of the plants in the plot had ears showing out the silk. A week after the silk stage of the latest maturing plot, ear height was measured in centimeters from the ground level to the point of attachment of the ear, and plant height was measured in centimeters from the ground level to the tip of the tassel. For each plot the number of plants that were root-lodging (reaching more than 45° from the vertical) or stalk-lodging (broken below the ear) was recorded. The extent of damage caused by pests and diseases was also recorded.

The harvested ears were dried to about 15 per cent moisture in the dryer of the Plant Breeding Division. They were weighed immediately before and after shelling. The moisture content for each plot was determined with the use of the Universal Moisture Tester and the yield of shelled grains was expressed in cavans per hectare at 15 per cent moisture.

RESULTS AND DISCUSSION

The dry-season yield test was split into early planting (replications I and II) and late planting (replications III and IV) because the area prepared for the plots was enough only for two replications. The land preparation for the two other replications was delayed by successive rains following the planting of replications I and II, thus replications III and IV had to be planted 18 days later.

The early and late plantings were analyzed separately and the yields per hectare at 15 per cent moisture together with the analysis of variance are given in tables 1a and 1b. In these tables and in other subsequent tables, designations of entries are used instead of the pedigrees to facilitate the discussion of synthetics with long pedigrees.

1956-57 Dry-Season Test

Grain yield of the first generation synthetics. The analysis of variance for replications I and II showed no significance for entry although Philippine Hybrid No. 1d, the outstanding double-cross hybrid used as check, gave the highest average yield of 54.3 cavans per

hectare whereas the lowest yielding synthetic (Syn. a_1) gave an average of 22.9 cavans per hectare. The lack of significance for entry may be attributed to the high coefficient of variation (C.V. — 22.26%) of the experiment.

Based on the average yields, however, most of the first generation synthetics yielded much higher than the two entries of College Yellow Flint. Syn. h_1, the best among the synthetics, yielded ten cavans more than the higher-yielding entry of College Yellow Flint.

The averages of replications III and IV showed that Syn. d_1 yielded the highest (23.7 cav./ha.) among the nine synthetics and almost equalled that of the double-cross check (23.9 cav./ha.). There were, however, no significant differences between the yield of the higher-yielding College Yellow Flint entry (19.1 cav./ha) and that of Philippine Hybrid No. 1d and most of the first generation synthetics. Syn. a_1 gave the lowest mean yield of 9.8 cavans per hectare.

The difference between the two replications, owing probably to the occurrence of soil fertility gradient towards one direction, was highly significant.

A summary of early (replication I and II) and late (replication III and IV) plantings showed that the double-cross check ranked the highest in yield followed by Syn. i_1, Syn. h_1, Syn. d_1, and Syn. g_1. The two entries of College Yellow, the open-pollinated variety used as check, ranked 10th and 11th while Syn. a_1 ranked last.

A test for homogeneity of the variances of the four replications was made using Bartlett's method. As the variances were found homogeneous, the late and early plantings were analyzed together in table I.

Highly significant differences were obtained among entries and among replications. The double-cross hybrid, however, did not yield significantly better than College Yellow. Although the mean yields of most synthetics were much higher than that of College Yellow, not even one yielded significantly better than the open-pollinated check variety.

The coefficient of variation was quite high (21.51%) as expected.

The yields in cavan per hectare of all entries were transformed into logarithms and analyzed so that the means and variances would

be independent. The analysis of variance of logarithms indicated that the variances for entry and replication were highly significant. The double cross hybrid and the synthetics still did not yield significantly better than College Yellow.

TABLE 1.—*Grain yield (in cavans per hectare at 15% moisture) of nine synthetic varieties and check (early and late plantings), 1956-57 dry season*

ENTRY	MEAN	ENTRY	MEAN
Synthetic a_1	16.4	Synthetic c_1	27.7
Synthetic b_1	29.9	Synthetic f_1	29.7
Synthetic c_1	27.7	College Yellow Flint	27.3
College Yellow Flint	26.7	Synthetic g_1	32.4
Synthetic d_1	33.6	Synthetic h_1	33.7
Philippine Hybrid No. 1d	39.1	Synthetic l_1	34.3

SIGNIFICANT DIFFERENCE	PROBABILITY LEVEL	
	0.05	0.01
Entry	15.69	18.98

Wet-season Test

Grain yield of first generation synthetics. The data on grain yield in the wet season of the first and second generation synthetics, College Yellow and Philippine Hybrid No. 1d are presented in table 2. Comparisons among the mean yields only of the first generation

TABLE 2.—*Grain yield (in cavans per hectare at 15% moisture) of first generation and second generation synthetics and checks, 1957 wet season*

ENTRY [a]	MEAN	ENTRY	MEAN
Synthetic b_1	64.0	Synthetic e_2	57.2
Synthetic b_2	67.2	Synthetic f_1	51.8
Synthetic c_1	54.1	Synthetic f_2	52.0
Synthetic c_2	57.5	College Yellow Flint	51.4
College Yellow Flint	50.8	College Yellow Flint$_1$	54.9
Colege Yellow Flint$_1$	57.5	Synthetic g_1	51.6
Synthetic d_1	57.1	Synthetic g_2	64.1
Synthetic d_2	53.4	Synthetic h_1	48.6
Philippine Hybrid No. 1d	66.5	Synthetic h_2	53.1
Philippine Hybrid No. 1d	67.0	Synthetic i_1	63.0
Synthetic e_1	51.2	Synthetic i_2	63.9

SIGNIFICANT DIFFERENCE	PROBABILITY LEVEL	
	0.05	0.01
Entry	7.82	9.30

[a] Synthetic 1_a had a very poor stand and was excluded.

synthetics show that Syn. b_1 (64.0 cav./ha.) and Syn. i_1 (63.0 cav./ha.) and Syn. i_1 (63.0 cav./ha.) yielded significantly more than the higher-yielding entry of College Yellow (51.4 cav./ha.). These two synthetics differed significantly in yield from Philippine Hybrid No. 1d (66.5 cav./ha.). Syn. h_1 gave the lowest yield of 48.6 cavans per hectare whereas the rest of the synthetics yielded about as much as College Yellow.

Grain yield of first and second generation synthetics. The analysis of variance for table 2 shows that there is no significant difference between the yields of the first and second generations of the eight synthetics, although most of the second generation synthetics yielded higher than the first generation. This result agrees with the findings of Sprague and Jenkins (1943)[9] who obtained approximately the same yield for both first and second generation synthetics.

Syn. b_2 (67.2 cav./ha.), Syn. i_2 (63.7 cav./ha.) and Syn. g_2 (64.1 cav./ha.) significantly outyielded the higher yielding entry of College Yellow (54.9 cav./ha.).

TABLE 3.—*Grain yield (in cavans per hectare at 15% moisture) of second generation and third generation synthetics, College Yellow Flint and recommended double crosses, 1958-59 dry season*

ENTRY	MEAN	ENTRY	MEAN
Philippine Hybrid No. 1d	21.72	Synthetic g_2	15.95
Synthetic e_2	14.97	Philippine Hybrid No. 3	23.50
Synthetic h_3	22.63	Synthetic i_3	20.09
College Yellow	23.29	Philippine Hybrid No. 7	22.92
Synthetic f_2	17.90		

SIGNIFICANT DIFFERENCE	PROBABILITY LEVEL	
	0.05	0.01
Entry	8.55	10.84

1958-59 Dry-season Test

The second dry-season planting which included only Syn. c_2, Syn. f_2, Syn. g_2, Syn. h_3, and Syn. i_3 because of limited seeds, showed the performance of the synthetics, College Yellow Flint, and three recommended double crosses under extreme drought conditions which prevailed from November, 1958 to February, 1959 (table 4).

Table 3 shows the yield in cavans per hectare of the synthetics

[9] *Op. cit.*

and the checks. The analysis of variance indicated no significant differences among the synthetics and the checks but showed highly significant differences among the replications. As may be seen from the results, even the Seed-Board approved double crosses (Phil. Hybrids No. 1d, 3 and 7); and Syn. h and Syn. i are no better than College Yellow Flint under extreme drought conditions. Based on mean yields the highest yielders according to rank are: Phil. Hybrid No. 3, College Yellow Flint, Phil. Hybrid No. 7, Syn. h_3 and Phil. Hybrid No. 1d which is supposedly the most outstanding and widely adapted among the recommended double cross hybrids.

Yields of the Synthetics in Relation to Their Pedigrees

Synthetic i_1 which had the best performance among the nine synthetics ranked second in the first dry-season test and third in the wet-season test. This synthetic is actually a second generation of Phil. Hybrid No. 1a [(A102 × A107) (A111 × A1113)] which is a double cross recommended by the Philippine Seed Board. Synthetic h_1 [(183 × A113) (A102 × A103)] [(A102 × A106) (A112 × A113)] *, ranked third in the first dry-season test and fourth in the second dry-season test but tenth in the wet-season test. On the other hand, Synthetic b_1, [(193 × 194) (A102 × A103)] [(A102 × A104) (A111 × A113)] *, performed better (second in rank) in the wet season test than in the dry season test (sixth in rank). Synthetic a_1 [(193 × 194) (A102 × A106)] [(117 × 118) (A111 × A113)]* and Synthetic e_1, [(118 × 180) (A102 × A103)] [(A102 × A106) (A112 × A106) (A112 × A113) *, had the poorest performance among the synthetics in both wet-season and dry-season tests.

A critical scrutiny of the pedigree of each synthetic shows that 8-line synthetics and those with inbred lines 117, 118 (both dent and from Florida, U.S.A.) and 180 (flint from Medellin, Colombia) are generally poor yielders. It is also worth noting that Syn. i_1, the only 4-line synthetic, and Syn. h_1, the only 6-line synthetic included in this study, yielded better than the 7-line and 8-line synthetics, although Syn. h_1 did not perform well in the wet-season test.

Other Agronomic Characters

Number of days to silking. The dry-season crops generally silked later than the wet-season crop, most likely because of the difference in the amount of available moisture during the vegetative growth of the plants (table 4). The difference between the lowest

TABLE 4.—*Rainfall readings for 1956-57 dry season, 1957 wet season, and 1958-59 dry season*

DAYS AFTER PLANTING	1956-57 DRY SEASON	1957 WET SEASON	1958-59 DRY SEASON
	inches	*inches*	*inches*
1–7	0.805	1.200	0.761
8–14	2.705	1.570	0.798
15–21	2.260	0.390	0.021
22–28	0.0	1.370	0.231
29–35	5.030	3.320	0.070
36–42	5.935	2.990	0.002
43–49	1.100	1.550	0.133
50–56	0.750	1.360	0.308
57–63	6.495	0.330	0.010
64–70	0.490	3.810	0.840
71–77	0.365	2.670	0.182
78–84	0.270	0.740	0.020
85–91	0.030	0.510	0.020
92–98	0.0	1.420	0.000
99–105	0.130	1.330	1.575
Total	26.365	24.560	4.971

and the highest number of days to silking in the first dry-season was 14 days; in the wet season, 8 days. There is a clear indication that those entries (Syn. c_1, Syn. f_1, and Syn. g_1) which silked latest in the first dry season were also the latest to silk in the wet season. Most of the synthetic varieties matured later than Phil. Hybrid No. d_1 and College Yellow Flint.

Ear and plant height. There is considerable difference in the ear and plant height between the dry-and-wet-season plants. No entries in the dry season exceeded 87 centimeters (Syn. c_1) in ear height, while 106 centimeters (Syn. e_1) was the lowest ear height in the wet season. The plant height of the different synthetics, hybrid, and College Yellow ranged from 188 to 205 centimeters for the first dry season, about 45 to 160 centimeters for the second season. The tallest or the shortest plant in the dry season, however, was not necessarily the same in the wet season.

Root- and stalk-lodging. The data on root- and stalk-lodging in percentages were computed based on the number of plants in a plot. There were only very small percentages of both kinds in the dry-season plantings. The large percentages of stalk-lodging in the wet season were mainly caused by a strong typhoon. Phil. Hybrid

No. 1d and Synthetics d_1 and d_2 apparently had weaker stalks as shown by the high stalk-lodging percentages.

Pest and diseases. The injury caused by the corn borer, *Pyrausta salentiales* Hubner, was not severe, but all the varieties were slightly to moderately infested. Pest infestation in the 1957 wet season and 1958-59 dry season trials was observed to be negligible.

The most prevalent disease observed in the 1956-57 season test was rust (*Puccinia sorghi* Schw.) which caused from slight to very severe injury in all the entries. Stalk rot disease caused by *Gibberella moniliformis* (Sheldon) Wineland incurred moderate injury to Phil. Hybrid No. 1d and slight injury to the rest of the entries. A slight infection of leaf spot caused by *Helminthosporium maydis* Nisikado and Miyake was observed on some of the synthetics and on the hybrid. In the 1957 wet-season crop, only Curvularia leaf spot was found infecting the plants, but damage inflicted was only slight to moderate.

CERCOSPORA LEAF SPOT OF SORGHUM [1]

FLORENDO C. QUEBRAL and LUCIO N. GIBE

Cercospora sorghi Ell. and Evht, can normally grow on agar media. The fungus produces conidia which remain viable for 4 to 6 months in the laboratory. Conidia in the field can be disseminated by wind and rain splashes. The fungus lives from season to season in the form of dormant mycelium within the infected tissues. Cross-inoculation showed that corn and Johnson grass can be infected by the fungus.

The disease may be controlled by sanitation, crop rotation, cultural practices, the use of resistant strains and varieties, and spraying the plants with fungicides such as Omadine, Orthocide 50, Fermate, and Spraycop "530".

This work is a continuation of the study on the cercospora leaf-spot of sorghum (*Cercospora sorghi* Ell. and Evht.) which was first observed in our experiment station on August 28, 1958; a preliminary report of which was made by Quebral and Gibe (1958).

MORPHOLOGY

To study the morphology of the causal organism, mature spores were streaked on potato-dextrose agar. Abundant mycelial growth developed within five days. Further transfers were made on sterile potato-dextrose agar slants. On this medium, the growth was at first floccose white, turning dull violet black, finally purple drabs [2] with radial ridges and concentric circles. Conidia were produced along the margin of the colony.

Mycelium. The aerial hyphae were hyaline, densely granular, smooth and continuous when young. With age they became vacuolate, septate, and sparingly branched. Submerged hyphae were light olivaceous, granular, and thick-walled (fig. 1a). The hyphal cells on a 10-day-old culture were 18.5μ long (range: 7-35μ) and 4.2μ in diameter (range: 3.5-7μ).

---

[1] Central Experiment Station Contribution No. 2012.

[2] All color names are from Robert Ridgeway's "Color Standards and Color Nomenclature" (1912).

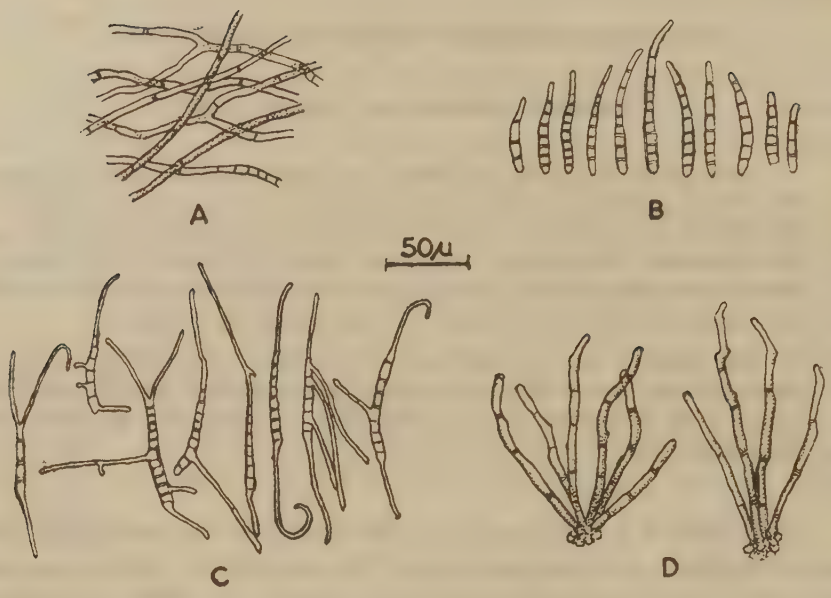

Fig. 1.—Camera lucida drawings: (A) mycelium of *Cercospora sorghi* taken from potato-dextrose agar culture, (B) conidia from infected leaves, (C) conidia germinating in distilled water, and (D) conidiophores.

Conidiophores. On mature lesions, the conidiophores were produced on both surfaces of the leaves but were present in greater numbers on the lower, less exposed side. They occurred in tufts or fascicles of 4 or 5 to as many as 20, protruding from the stomata. The stromata were indistinct and often appeared as aggregated basal cells of the conidiophores (fig. 1d).

The conidiophores viewed under the microscope were light brown to dark brown in color. They were simple, 1 to 5 septate and showed prominent geniculations and spore scars. As many as 5 spore scars were counted on a single conidiophore.

Conidiophores from infected leaves were from 31.5 to 178.5 by 3.5 to 5.2μ in size, the average size being 105.7 by 3.9μ.

Conidia. The conidia were multiseptate granular, and hyaline. They were broad at the base and tapering toward the apex, straight to mildly curved. The base was usually truncate and bears a scar marking the place of attachment to the conidiophore (fig. 1b). The septa varied in number from 3 to 11. On the leaves, the conidia

TABLE 1.—*Growth characteristics and conidial production of Cercospora sorghi on various agar media*

MEDIUM	GROWTH CHARACTERISTICS	PRODUCTION OF CONIDIA	DIAMETER OF COLONY AFTER 10 DAYS *	AVERAGE DAILY GROWTH
Potato-dextrose agar	thin and floccose, white turning dull violet black then finally purple drab	abundant	31.5	3.15
Sorghum-dextrose agar	abundant dull white to olive green mycelial growth	scarce	37.3	3.73
Sorghum agar	dense compact olive green mycelial growth	none	27.6	2.76
Malt agar	dense compact white, then finally purple drab	none	31.0	3.10
Oatmeal agar	thin and floccose olive green with narrow white margin	none	28.0	2.80
Bean agar	fairly thin gray mycelial growth	none	26.0	2.60
Potato-sucrose agar	dense floccose white, finally dark purple gray with purple drab margin	fairly abundant	28.6	2.86
Czapek's agar	dense compact olive grey with radial ridges, bottom mat light, ochraceous buff	scarce	25.0	2.5
Nutrient agar	thin dull white mycelial growth	none	20.0	2.00
Water agar	very thin white mycelial growth	none	8.0	0.80
Onion agar	dense floccose smoke gray with fairly white margin	fairly abundant	22.0	2.20
Corn-meal agar	dense fluffy olive green with white narrow margin	scarce	32.0	3.20
Sorghum-sucrose agar	thin olive green with narrow white margin	none	30.0	3.00
Nutrient-dextrose agar	dense floccose, pale payne's gray, then finally purple drab	fairly abundant	24.5	2.45

* Average of three plates.

ranged in size from 42 to 112 by 3.5 to 7μ, the average size being 77.3 by 5.3μ.

PHYSIOLOGY

Growth and conidial production of the fungus on various agar media and substrates. The growth characteristics and conidial production of the fungus were studied on 14 different culture media (table 1), and on 5 substrates—potato tubers, corn stem, sorghum stem, sugar cane stalk, and sorghum leaf.

Fig. 2.—Growth and sporulation of *Cercospora sorghi* Ell. and Evht. on various agar media after 10 days: (A) malt agar, (B) Czapek's agar, (C) potato-dextrose agar, (D) potato-sucrose agar, (E) sorghum-dextrose agar, (F) sorghum-sucrose agar, (G) corn-meal agar, (H) oat-meal agar, (I) onion agar, (J) nutrient agar, (K) bean agar, (L) water agar, and (M) sorghum agar. (*Photograph taken by the Photographic Division*).

The fungus showed comparatively good mycelial growth on all substrates (fig. 2; table 1). Sporulation was abundant on corn stems, potato tubers, and sorghum leaf, fairly abundant on sugar cane stalks, and scarce on sorghum stems.

The ability of the fungus to grow at different pH levels was tested on 10 cc. triplicate cultures of potato-dextrose agar. The pH was adjusted to range from 3.0 to 9.5 using a Beckman pH meter and sterilized N/10 HCl or N/10 NaOH. The contents of each test tube of agar with the adjusted pH were poured into a sterile Petri

dish, spread evenly, allowed to congeal, uniformly inoculated, and incubated at room temperature (27-28°C.). The results are presented in table 2.

TABLE 2.—*Growth and conidial production of Cercospora sorghi on potato-dextrose agar at different hydrogen-ion concentration*

pH OF MEDIA	COMPARATIVE ABUNDANCE OF MYCELIUM	COMPARATIVE ABUNDANCE OF CONIDIA	DIAMETER OF COLONY IN MM. AFTER 10 DAYS *	AVERAGE DAILY GROWTH IN MM.
3.0	scarce	none	10	1.0
3.5	scarce	none	14	1.4
4.0	abundant	scarce	23	2.3
4.5	fairly abundant	scarce	25	2.5
5.0	fairly abundant	fairly abundant	26	2.6
5.5	fairly abundant	fairly abundant	25	2.5
6.0	fairly abundant	fairly abundant	22	2.2
6.5	fairly abundant	fairly abundant	27	2.7
7.0	fairly abundant	scarce	21	2.1
7.5	scarce	fairly abundant	23	2.3
8.0	scarce	abundant	26	2.6
8.5	fairly abundant	scarce	20	2.0
9.0	abundant	fairly abundant	22	2.2
9.5	abundant	fairly abundant	22	2.2

* Average of three cultures.

Mycelial growth was abundant at pH 9.5. In general, at pH 6.0 to 8.5, growth proceeded at a markedly slower rate than on more acid media. Sporulation was most abundant on pH 8.0 and fairly abundant on the rest of the alkaline media. Growth was retarded at pH 3.0 and 3.5 producing whitish or pinkish compact mycelium (fig. 3).

Germination of conidia. On January 17, 1959, conidia from infected leaves of the host were germinated in tap water, rain water, and nutrient broth in van Tieghem cells and on potato-dextrose agar, onion agar, nutrient agar, and water agar blocks at laboratory temperature.

The conidia germinated within 1 to 2 hours in tap water, nutrient agar, water agar, and onion agar. Germination took place within 3 to 4 hours in potato-dextrose agar and rain water. In nutrient broth the conidia germinated after 5 hours; and in sterile distilled water, within 45 minutes. Typical germination was by the production of bipolar, hyaline germ tubes. Germination by the pro-

duction of a single germ tube from either the basal or apical cell was also observed. Occasionally, a typical germination by the production of a germ tube from one or more of the intermediate cells also occurred (fig. 1c).

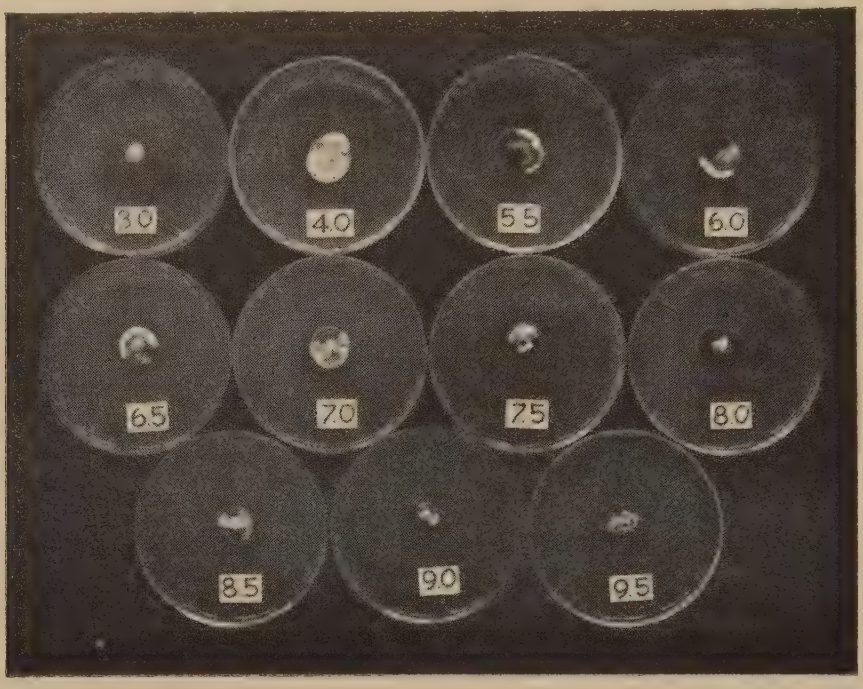

Fig. 3.—Growth and conidial production of *Cercosporua sorghi* after 10 days on potato-dextrose agar with pH ranging from 3.0 to 9.5. (*Photograph taken by the Photographic Division*).

Viability of the fungus. Conidia on diseased sorghum leaves when placed in a closed dry receptacle failed to germinate in sterile distilled water after four months.

The fungus in potato-dextrose agar plate remained viable for five months, while that in potato dextrose agar slant, for more than six months.

TAXONOMY

The fungus that causes Cercospora leaf spot of sorghum is listed by Saccardo and Chupp as *Cercospora sorghi* Ellis and Everhart. The fungus is described as follows: conidiophores medium dark brown or olivaceous brown; multiseptate, not branched, 1-3 geni-

culate, 20-80, rarely 150 × 3-5.5μ; conidia hyaline, acicular to obclavate or almost cylindric, indistinctly multiseptate, base truncate to obconically truncate, 30-70 × 2-4, rarely 300 × 5-5.5μ. Furthermore, the symptoms of the disease caused by the Philippine *Cercospora* closely resemble those of the disease caused by Cercospora sorghi as described by Chupp (1953), and Leukel and Martin (1944). The writers, therefore, identify the fungus causing Cercospora leaf spot of sorghum in the Philippines as *Cercospora sorghi* Ell. and Evht.

PATHOGENICITY

A suspension of conidia was obtained by scraping diseased tissues in water and this was sprayed on the leaves of four-week old sorghum seedlings [3] growing in the greenhouse. After five days in the damp chamber, small water-soaked spots (the first evidence of infection) were found on the leaves of the treated plants; in contrast, no spots were noted in the control. In less than a month the spots had become typical of Cercospora lesions and bore conidiophores and conidia.

Another inoculation test was made using conidia from pure cultures. The conidia were obtained by gently washing the surfaces of 20-day-old cultures (on potato-dextrose agar) with distilled water. The conidial suspension were atomized on four healthy sorghum plants which had been growing for two months in the greenhouse. Both treated plants and the control were placed in the moist chamber for 3 to 4 days. The first visible evidence of infection was observed eight days after inoculation. Two weeks after the appearance of the first visible symptoms, the spots had produced conidiophores and conidia typical of the fungus used in making the inoculations. From these mature lesions the fungus was recovered in pure culture by streaking spores on plated potato-dextrose agar.

In another inoculation test, bits of agar with mycelial fragments were smeared on uninjured and injured portions of the leaves of four-week-old sorghum plants. Infection was noted on the injured leaves five days after inoculation, while no visible evidence of infection was found on the uninjured leaves. But at the time of the next observation, eight days after inoculation, many spots were in evidence on the uninjured leaves.

[3] Planting materials were provided by Mr. Fernando Bernardo of the Division of Plant Breeding, Department of Agronomy.

In all inoculation experiments the control plants were not infected.

Strain and varietal susceptibility and resistance. Under favorable conditions, the disease may attack almost any variety and strain present in a locality. In Central Experiment Station, College, Laguna, a great number of introduced varieties and strains showed infections of different degrees.

On the basis of spots per leaf area and number of diseased leaves per plant among field grown specimens (and presuming that spores were evenly dispersed in a naturally infected field), the reaction of strains and varieties to the disease follows:

Highly susceptible

Dwarf Yellow Milo	D.D. White Sooner Milo
Miloca	California White Durra
Cheyenne	Greeley
Chinese amber	Dwarf Freed
Grohome	Shallu

Moderately susceptible

Dwarf White Milo	Freed
D.D. White Milo	Std. Yellow Milo
D.D. Yellow Milo	Red Feterita
Dwarf Feterita	Schrock
Combine 7078	Norghum

Highland Kafir

Slightly susceptible

Alliance Kafir	Dwarf Freed
Red Combine	Ey. White Milo
Finney	Dwarf Ey. Yellow Milo
Feterita	Std. Bh. Kafir
Texas Bh. Kafir	Texas Dwarf White Milo

Resistant

Martin	Rice Kafir
Pink Kafir	Caprock
Cluster	Top Sprghum
Hegair	Pygmy
African Kafir	Sharon Kafir

Host range. The following species of plants belonging to the grass family were cross-inoculated to determine whether the pathogen would infect plants other than sorghum: Dallis grass, *Paspalum dilatatum* Poir; Johnson grass, *Andropogon halepenses* Bret; Para grass, *Panicum purpurascens* Raddi; Crab grass, *Digitaria sanguinalis* (L) Scoop; Alabang X, *Andropogen nodosus* (Willem.) Nash; "mala-palay," *Leptochloa filiformis* (Lam.) Beauve; Barit, *Leersia hexandra* Swartz; Molasses grass, *Melinis minutiflora* Beauve [4]; and corn, *Zea maize.* These plants were grown in pots and inoculated with a spore suspension of the fungus taken from diseased sorghum leaves. All other treatments were similar to those employed in previous inoculation experiments. Control plants of each species were provided.

Of the nine species inoculated, Johnson grass and corn proved susceptible to the disease. The lesion on corn is an elongated spot with purplish border. The center of the spot is brown at first and later black. On Johnson grass the lesion is similar to that on sorghum but smaller in size and has a more or less definite reddish-brown border. The rest of the species were not infected even after repeated sprayings with spore suspension. Chupp (1953) recorded that the fungus attacks corn; hence, the variety *maydis* may be attached after the name of the causal fungus.

Seasonal production of the disease. Since the disease is usually severe in the rainy season (June to October), the writers tend to consider moisture as one of the important factors influencing the development of the disease. Wells (1925) observed that several species of *Cercospora* formed larger fruiting structures during periods of heavy precipitation than during dry weather.

Methods of penetration. Inoculation experiments have shown that the organism is capable of penetrating uninjured leaves directly through the epidermis and through the stomatal openings. It is also probable that infection in the field takes place through injuries caused by insects and man during cultural operations.

Dissemination. The spread of the disease is effected to a considerable extent by conidia carried by the wind. Rain splashes, although probably not important in long-distance dissemination of the spores, may serve as important agents in the spread of the causal fungus from infested soil to leaves close to the ground.

[4] Identified by Mr. Juan V. Pancho of the Department of Agricultural Botany.

The fungus tides over on dead tissues of the host living as a saprophyte and may persist in the form of dormant mycelium. As soon as weather conditions become favorable, the fungus again grows and sporulates. These spores become the source of primary infection for the succeeding crop.

Infection on new sorghum may also be initiated by spores from surrounding infected corn and Johnson grass. Abundant spores from these diseased plants may serve as inoculum for secondary infection.

CONTROL MEASURES

The disease may be controlled by (1) burning all diseased leaves and other parts of the plant, (2) rotating crops so that sorghum would be absent from the field at least during growing season, (3) timing the crop so that the growing period will not coincide with the heavy rains, (4) planting resistant varieties and/or (5) spraying the crop with fungicides.

A laboratory test was conducted using Spraycop "530", Fermate, Orthocide 50 and Omadine. Glass slides in duplicate were sprayed with each of the fungicides and allowed to dry. Drops of spore suspension from diseased leaves were put on the slides, and the latter were incubated at room temperature in Petri dishes lined with moist cotton. Observations at 24 and 48 hours indicated the Omadine and Orthocide 50 at 2 pounds per 100 gallons completely prevented conidial germination. Three or four conidia germinated on slides sprayed with Fermate at 2 pounds per 100 gallons and those with Spraycop "530" at 4 pounds per 100 gallons.

LITERATURE CITED

CHUPP. C. 1953. A monograph of the fungus genus *Cercospora*. 667 p. Ithaca, New York.

LEUKEL. R. W. and J. H. MARTIN. 1944. U.S.D.A. Farmer's Bulletin, **46.**

RIDGWAY, ROBERT. 1912. Color Standards and Color Nomenclature. 42 p. Washington, D.C.

SACCARDO, P. A. 1884. Syllogue fungorum. **10,** 964 p. Ann Harbor, Michigan: Edwards Brothers Inc.

WELLS, C. G. 1925. Taxonomic studies of the genus *Cercospora* in the Philippine Islands. *Am. Jour. Bot.* **12:** 195-218.

EFFECTS OF PUMP IRRIGATION ON FARM ORGANIZATION, OPERATION, AND INCOME OF RICE FARMS IN STO. DOMINGO AND LA PURISIMA, NABUA, CAMARINES SUR [1]

JESUS C. STA. IGLESIA and JOSE M. LAWAS [2]

Pump irrigation did not change the organization of rice farms in Sto. Domingo and La Purisima. The proportions of the different assets during the business year preceding the installation of an irrigation system are similar to those during the year following the installation. Land constituted two-thirds of the total investment, dwelling one-fifth and the other buildings, work animals, other livestock, tools, equipment and supplies collectively accounted for one-seventh.

On the other hand, some operations were changed. More farmers planted rice by the direct method (broadcast) during the first study year; more used the indirect method in the second.

Rice yields during the two study years differed by about four cavans per hectare in favor of the second year. There was however, no significant change in incomes because the increase in production was probably offset by the decrease in price.

The pump irrigation program of the Philippines has been primarily geared to rice production. This is demonstrated by the location of pump projects. Nearly ½ or 113 projects of the 245 are in six provinces of Central Luzon, the Rice Bowl of the country; the other 132 are distributed among 29 provinces.

The emphasis of the program on rice production may be explained thus:

1. Rice is the most important crop of the Philippines,
2. Production of rice in the country has always been short of consumption,

---

[1] Central Experiment Station Contribution No. 2013. Part of Projects No. 1084 and 797, respectively. Taken from the authors' unpublished M.S. theses, "Effects of Irrigation on Farm Organization and Resource Productivity for a Sample of Philippine Rice Farms," University of Kentucky, Lexington, Kentucky, 1959, and "Preliminary Analysis of the Effect of Pump Irrigation on Farmers' Income," University of the Philippines, Diliman, Philippines, 1956.

[2] Respectively an assistant instructor in the Department of Agricultural Economics and Statistician III of the Division of Agricultural Economics, DANR.

3. Per hectare productivity of Philippine rice farms has been consistently low, and
4. Rice culture is highly demanding of water.

The Irrigation Service Unit (ISU), the implementing agency, has installed 211 pumps from 1952 up to 1957 covering 39,804 hectares of irrigable land.

Data on 142 projects show that ISU spent an average of ₱36,107 per project with construction and installation cost representing the biggest single expense category. It comprises ₱19,238 or more than one-half of the total. The pump and the engine costs are about equal (table 1).

TABLE 1.—*Cost of pump projects in the Philippines, 1952-1957* [a]

IRRIGATION DISTRICT	NUMBER OF PROJECTS	COST IN PESOS			
		Pump	Engine	Construction & Installation	Total [b]
I	15	82,701	64,762	222,328	444,315
II	5	18,738	18,285	77,934	137,472
III	16	72,982	82,018	261,397	495,804
IV & V [c]	40	169,151	154,999	391,967	866,906
VI	30	125,783	96,184	373,963	731,156
VII	18	194,473	185,795	752,786	1,346,443
VIII	8	38,279	50,024	232,552	391,208
IX	7	71,601	74,789	330,235	572,522
X	3	11,432	15,279	88,606	141,436
Philippines	142	785,140	742,135	2,731,768	5,127,262
Average per project		5,529	5,226	19,238	36,107

[a] Basic data supplied by Mr. S. Banilan, Head, Field Service Division, Irrigation Service Unit.

[b] Total includes all other costs, i.e., costs of fuel and oil advanced, ten per cent of the first three columns above and the compensating tax.

[c] Two districts are hereby combined due to difficulty in separating projects of a divided province, Bulacan.

As one of its objectives, this study attempted to answer the following questions: Will the rice situation in the country be improved with the pump irrigation program? What effect has irrigation on farm organization, operation, and income? Does the increase in production, if any, more than cover the costs of irrigation? What are the problems attendant to establishing an irrigation system?

Answers to the above and other such questions are needed by policy-makers, agricultural and other government officials, community leaders and farmers. Such information will determine whether the pump irrigation program is economically justifiable. It will gauge whether the farmers concerned will be capable of paying for the costs of the irrigation system, its operation and maintenance. It will provide some basis for improving the program and checking or minimizing its shortcomings.

Data for the 1954-1955 cropyear were gathered from all 216 farmers of an unirrigated area who signed up for membership in a proposed irrigation association at the time the survey was planned. Another survey was made for the cropyear 1956-57 after the pump irrigation system has started operations. The second enumeration included 176 farmers of the original sample. The other farmers were left out for various reasons: two refused to be interviewed, some transferred residence or were not in the area at the time, and others no longer operated all or part of their farms.

Additional data were obtained from the management of the irrigation association and four other projects with reference to problems of and plans to improve the operation of the irrigation system.

THE STUDY AREA

The survey farms are located in two adjacent farming barrios, La Purisima and Sto. Domingo, 7 and 5.5 kilometers respectively, from the poblacion of Nabua. The poblacion is 53 kilometers southeast of Naga City and 63 kilometers northwest of Legaspi, Albay.

Travel in the area is mainly by bus or by boat. The Bicol river which traverses the area is used for navigation purposes in addition to its being the source of irrigation water.

Rainfall. Data for the study area are not available but records for Bato, Iriga, and Naga City may provide bases for approximation. Iriga is five kilometers northeast and Bato is six kilometers southeast of Nabua. Naga City is about 32 kilometers, (53 by road) northwest.

The rainfall of the three places are comparable. January, through April are months of low rainfall. May and June have more; July is a high rainfall month for Bato and Irriga. A slight dip occurs in August. September, October and November are high rainfall months. Rainfall begins decreasing in December (table 2).

TABLE 2.—*Rainfall at three stations of Camarines Sur*

	BATO	IRIGA	NAGA CITY
Years of record	13.00	14.00	37.00
		inches of rainfall	
January	4.89	4.90	4.52
February	2.85	3.56	3.20
March	3.13	3.79	2.71
April	2.03	2.38	3.40
May	5.60	7.42	6.13
June	7.92	11.76	7.96
July	15.06	16.70	10.80
August	7.24	9.86	7.36
September	13.70	14.94	11.47
October	8.56	10.43	11.50
November	10.15	11.87	12.15
December	6.44	7.06	11.42
Annual	87.57	104.67	92.62

Source: Eugenio B. Manalo, "The Distribution of Rainfall in the Philippines," *Philippine Geographical Journal*, IV (October-November, 1956).

Soils. The soil in the area is predominantly clayloam and loam. The different horizons have the following ranges measured in centimeters: surface, 20-30; subsoil, 60-70; and substratum, 130-150. Drainage is generally fair.

THE PUMP IRRIGATION SYSTEM

The Irrigation Service Unit installed a pump irrigation system in the area after certain requirements [3] were satisfied. The system shall be operated and paid for by the Sto. Domingo-La Purisima Irrigation Association, Inc.

Power was supplied by three 105 horsepower diesel engines with a maximum speed of 1,200 revolution per minute. Each engine was connected to a 20-inch pump which had a rated capacity of 10,000 gallons per minute (table 3).

The total cost of the system was ₱143,925. This included (a) cost of equipment (pump and engine); (b) cost of survey, design, installation and construction; (c) compensating tax to the Philippine government; (d) advance salary of the mechanic for the first two months; and, (e) administration expenses which was 10 per cent of the total of (a) and (b).

[3] For the requirements and procedures, see: Irrigation Service Unit, *Guiding Principles and General Procedures in the Installation and Operation of Irrigation Pumps*, Manila, 1956 (Mimeographed).

TABLE 3.—*General information on the Sto. Domingo–La Purisima Irrigation system*

Pump	
Type	Byron Jackson
Number of units	3
Size of units (per)	20 inches
Lift	17 feet
Discharge	10,000 gpm.
Engine	
Type	Deutz A6M 517
Fuel consumption per hour	6.2 gallons
Horsepower per engine	105
Revolution per minute	1,200
Length of canals	
Main	5,350 meters
Laterals	4,660 meters
Length of farm ditches	4,265 meters
Irrigable area	900 hectares

Source of data: Annual Report of the Irrigation Service Unit for the year ending June 30, 1957 (Manila: Department of Public Works and Communications, 1957), pp. 96 and 127.

The total was to be paid by the irrigation association to ISU in ten equal annual amortizations with 6 per cent interest. This is equivalent to a yearly investment of ₱15 per hectare based on 1000 hectares.

The fuel and lubrication costs for one season amounted to ₱4,183.95 (table 4). Fuel costs represented the largest cost, 88 per cent of the total. Oil and grease accounted for 11 and one per cent, respectively.

TABLE 4.—*Fuel and lubrication expenses from April 30 to December 18, 1956* [a]

ITEM	QUANTITY	PESOS
Fuel	26,638 liters	3,681.37
Oil	755 liters	476.81
Grease	33 pounds	25.77
Total	XXXX	4,183.95

[a] Information supplied by the President-Project Manager of the association.

FARM SIZE AND LAND USE

Rice, the most important crop in the area, was planted to about three-fourths of the average farm. The area devoted to "other

fields" increased in 1956-1957 possibly due to shifts in other land use. Coconut plantations which were damaged by *cadangcadang* tended to become corn or *camote* fields. The total farm area had no significant change (table 5).

TABLE 5.—*Size of farm and land use*

	LOWLAND RICEFIELDS	OTHER FIELD	COCONUT PLANTATION	FARM-STEAD	TOTAL FARM
			hectares		
La Purisima					
1954–1955	1.8	0.2	0.2	0.2	2.4
1956–1957	1.8	0.7	0.1	0.1	2.7
Sto. Domingo					
1954–1955	1.2	[a]	[a]	0.2	1.4
1956–1957	1.0	0.2	[a]	0.1	1.3
Both Barrios					
1954–1955	1.5	0.1	0.1	0.2	1.9 [b]
1956–1957	1.4	0.4	0.1	0.1	2.0
			per cent		
Both Barrios					
1954–1955	78	7	5	10	100
1956–1957	70	21	3	6	100

[a] Less than 0.1 hectare.
[b] Difference between two years has a *t*-value of 0.17 which is not significant at 50 per cent level.

FARM PRACTICES

Irrigation. The irrigation system supplied water for the wet season of 1956-1957. Operation of the system were suspended during the dry season and the succeeding year because of administrative difficulties and supervision problems which will be discussed in a separate section.

More than one-half of the 176 farmers studied in 1956-1957 did full irrigation; one-fourth did partial irrigation; and, about one-sixth did not irrigate (table 6).

There were more irrigated farms in Sto. Domingo than in La Purisima. This may be because the pump and power unit was located in Sto. Domingo.

Method of planting rice. The method of planting rice changed with irrigation. Of 216 farmers in 1954-1955, 16 per cent used the indirect method, i.e., growing the rice first in seedbeds and later transplanting the seedlings into the fields. The other 84 per cent broadcast the seeds directly into the fields.

TABLE 6.—*Farms by irrigation,*[a] *1956–1957*

	NUMBER	PER CENT
La Purisima	*80*	*100*
Fully irrigated	40	50
Partially irrigated [b]	18	22
Non-irrigated	22	28
Sto. Domingo	*96*	*100*
Fully irrigated	63	66
Partially irrigated [b]	26	27
Non-irrigated	7	7
Both Barrios	*176*	*100*
Fully irrigated	103	59
Partially irrigated [b]	44	25
Non-irrigated	29	16

[a] Classification based on lowland ricefields only.
[b] Farms with more than one ricefield, not all of which were irrigated.

The relationship was reversed in 1956-1957. Those who used the indirect method rose to 72 per cent of 126 out of 176 farmers. Those who used direct method dropped to 11 per cent. A third group of farmers used both methods and were classified under the "combination" category (table 7).

TABLE 7.—*Farms by method of planting rice*

	METHOD	FARMS	PER CENT
		1954-55	
Both Barrios	*Total*	*216*	*100*
	Indirect	35	16
	Direct	181	84
		1956-57	
Both Barrios	*Total*	*176*	*100*
	Indirect	126	72
	Direct	20	11
	Combination [a]	30	17
La Purisima	*Total*	*80*	*100*
	Indirect	51	64
	Direct	15	19
	Combination [a]	14	17
Sto. Domingo	*Total*	*96*	*100*
	Indirect	75	78
	Direct	5	5
	Combination [a]	16	17

[a] Farms with both indirect and direct.

The relationship of irrigation and method of planting is seen again when the two barrios were compared (table 8). There were more farmers who used the indirect method in Sto. Domingo, possibly because irrigation was more extensively practised.

TABLE 8.—*Farms by method of planting rice and irrigation, 1956–1957*

METHOD OF PLANTING	FULLY IRRIGATED	PARTIALLY IRRIGATED [a]	NON-IRRIGATED
		number	
Indirect	92	23	11
Direct	3	2	15
Combination	8	19	3

[a] For classification, see table 6.

Weeding. One major operation which required much labor was weeding. This was done more with the direct method. Ninety per cent of the farmers using direct method in 1954-1955 weeded their fields; in 1956-1957 nineteen out of 20 farmers.

Weeding comprised almost all of the general care given the plants. It was 92 per cent for the indirect method, 99 per cent for the direct, and 97 per cent for the combination group (table 9).

TABLE 9.—*Weeding on wet season rice crop, 1956–1957*

	METHOD OF PLANTING		
	Indirect	Direct	Combination
Total Farms	126	20	30
Farms reporting weeding	53	19	27
Per cent reporting weeding	42	95	90
Man days weeding per farm	22	40	40
		Man days per hectare	
General care of plants	7.5	27.0	20.8
Weeding	6.9	26.7	20.2
Per cent weeding	92.0	99.0	97.0
All operations [a]	51.0	50.9	56.5
Per cent weeding	13.5	52.5	35.8

[a] Less harvesting.

Rice varieties used. There were eight varieties of rice grown in 1956-1957. The most grown were *Dali, Pinorsigue,* and *Senador. Dali* was grown by 67 per cent of 176 farmers; *Pinorsigue,* by 19 per cent; and *Senador,* by 14 per cent (table 10).

TABLE 10.—*Rice varieties, 1956–1957*

VARIETY	LA PURISIMA	STO. DOMINGO	BOTH BARRIOS
		Farm reporting [a]	
Dali	44	75	119
Pinorsigue	36	—	36
Senador	8	16	24
Maginsalay	4	3	7
Bulao	1	—	1
Kinawayan	—	1	1
Pulutan	1	—	1
Sinaguing	1	1	2
		Per cent [b]	
Dali	25	42	67
Pinorsigue	19	—	19
Senador	5	9	14
Maginsalay	2	2	4
Bulao	1	—	1
Kinawayan	—	1	1
Pulutan	1	—	1
Sinaguing	1	1	2

[a] Some farms reported more than one variety.
[b] Based on 176 farms.

LABOR REQUIREMENTS IN RICE PRODUCTION

The method of culture influenced the number of man days required in growing rice. The indirect method required more labor than the direct method which had no seedbed preparation. It took less time to broadcast the seeds directly into the fields than to transplant the seedlings. The indirect method, on the other hand, required less days for general care which consisted mostly of weeding (table 11).

Total labor used on the ricefarms studied was distributed over an 8-month span for the wet season. A few farmers started seedbed preparation in late March. A labor peak was reached in May and June with field preparation and planting (or transplanting). The need for labor dropped in the months of July and August because not much general care was given the crop. Another labor peak occurred during the harvest months—in the late September, October, and November (figure 1).

The implications of labor peaks will be better understood when the farm labor situation is inspected. A total of 26.6 months of labor was available on the farm in 1954-1955 of which 5 months were used

TABLE 11.—*Man labor days on the wet season rice crop*

	1954-1955		1956-1957		COMBINATION
	Indirect	Direct	Indirect	Direct	
Number of farms	35	181	126	20	30
	days per hectare				
Seedbed operations	4	—	4.8	—	3.3
Repair of dikes	2	—	1.4	1.1	1.5
Plowing fields	12	11	11.0	10.8	10.7
Harrowing fields	12	10	9.6	9.2	8.7
Transplanting[a] or broadcasting	15	1	16.7	2.8	11.5
General care	5	9	7.5	27.0	20.8
Subtotal	*52*	*41*	*51.0*	*50.9*	*56.5*
Harvesting, hauling and threshing[b]	36	30	27.2	22.4	30.0
Cleaning and drying	6	10	2.7	2.1	1.8
Total	92	72	80.9	75.4	88.3

[a] Includes pulling, bundling, and trimming of seedlings, and transplanting.
[b] The value of harvesters' and threshers' share was transformed into days at the rate of one peso per day.

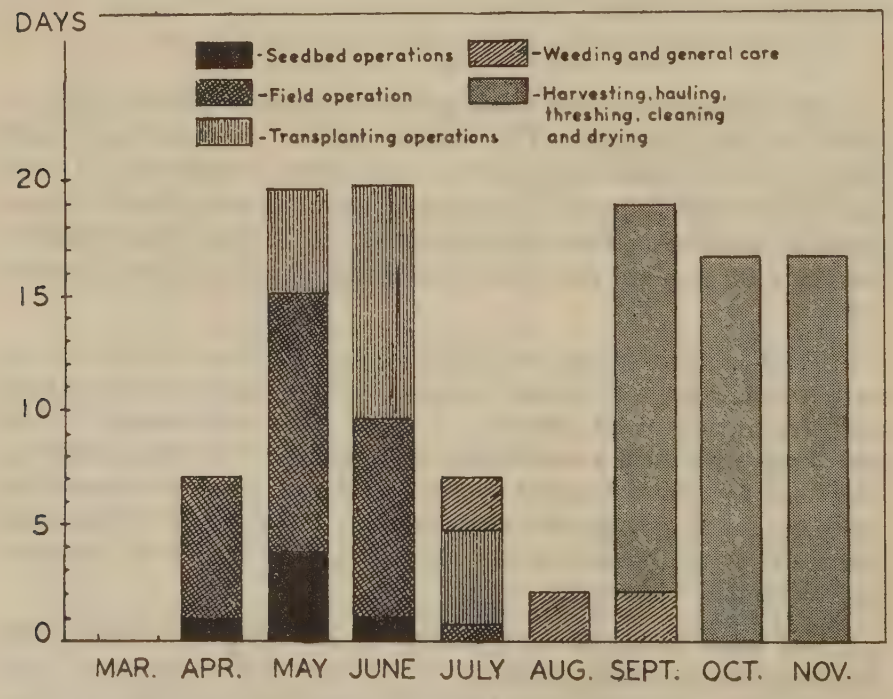

Fig. 1.—Man labor distribution by months on wet season rice production.

on the farm and 6.9 months on non-farm work. This proportion is comparable to the finding of Oppenfeld.[4] Nine months out of 28.3 available months of labor were utilized in productive farm labor; 6.2 months in off-farm work.

Farm labor is thus in excess. It would be more desirable to flatten out the peak and utilize as much own labor on the farm. Irrigation can definitely help alleviate the excess farm labor situation since more labor will be needed with two crop seasons.

RICE YIELDS

Yields by location and irrigation. Sto. Domingo ricefields had a higher productivity than La Purisima in both study years (table 12 and figure 2).

TABLE 12.—*Rice yields of wet season crop by location and irrigation*

	FARMS	CAVANS PER HECTARE		PER CENT CHANGE
		1954-1955 [a]	1956-57	
La Purisima	*88*	*22.2*	*26.2*	*18.0*
Fully irrigated	40		31.9	43.7
Partially irrigated	18		21.5	–3.2
Non-irrigated	22		21.6	–2.7
Sto. Domingo	*96*	*26.9*	*30.7*	*14.1*
Fully irrigated	63		34.2	27.1
Partially irrigated	26		29.7	10.4
Non-irrigated	7		10.4	–61.3
Both Barrios [b]	*176*	*24.2*	*28.1*	*16.1*
Fully irrigated	103		33.0	36.4
Partially irrigated	44		25.4	5.0
Non-irrigated	29		19.4	–19.8

[a] Irrigation system not yet established.
[b] The difference between the two wet season averages is significant at the 1 per cent probability level ($t = 3.40$).

Sto. Domingo Farms averaged 26.9 cavans per hectare in the first survey while La Purisima, 22.2 cavans. Productivity in the second study year was higher than the first. The average production in Sto. Domingo and La Purisima in the second survey was 30.7 and 26.2 cavans per hectare respectively. The average for both barrios combined changed from 24.2 to 28.1 cavans per hectare.

[4] Horst von Oppenfeld, *et al.* "Farm Management, Land Use and Tenancy in the Philippines." *Central Experiment Station Bulletin,* **1** (1957).

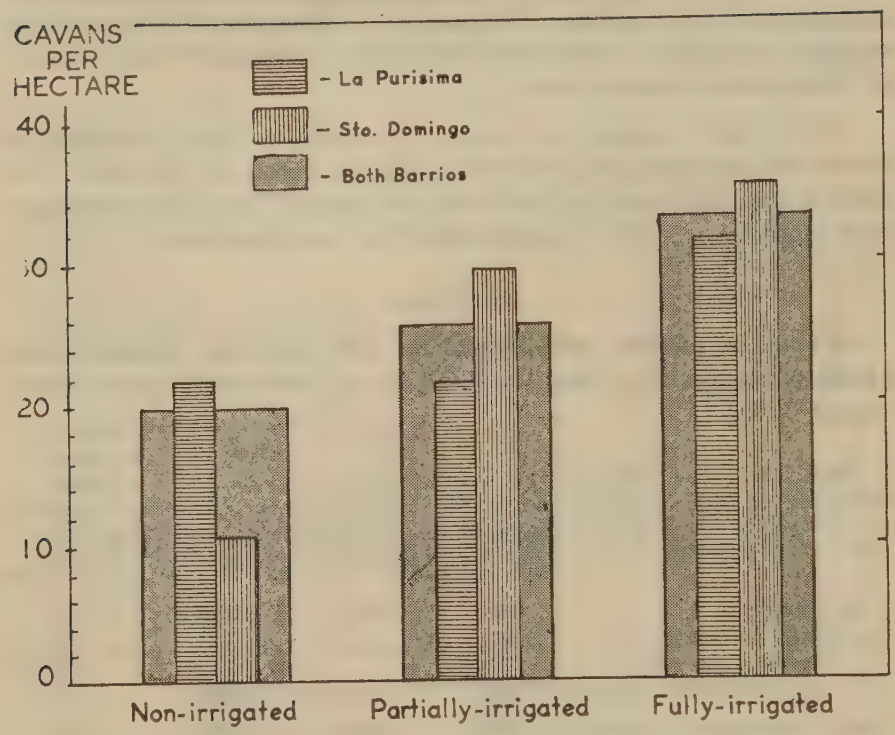

Fig. 2.—Rice yields according to degree of irrigation and location.

The increase in yields in 1956-1957 over 1954-1955 showed the influence of irrigation on yields. This was further substantiated by the yield difference among farms grouped according to degree of irrigation. The fully irrigated farms averaged 33.0 cavans per hectare; the partially irrigated, 25.4; and the non-irrigated, 19.6.

Yields by variety. The different varieties exhibited different yield averages. *Senador* had the highest, 34.3; *Pinorsigue* followed closely with 33.3. The most commonly grown variety, *Dali,* had only 30.3 (table 13).

THE FARM BUSINESS

Farm inventory. The proportion of the different assets for the two farm business years were comparable. Land was the largest single item of investment, constituting about two-thirds of the total; dwelling ranked second, accounting for one-fifth. The rest, which

accounted for one-seventh, consisted of other buildings, work animals, other livestock, tool, equipment, and supplies (table 14).

TABLE 13.—*Rice yields by variety, 1956–1957*

	VARIETY	FARM [a]	CAVANS PER HECTARE
La Purisima	Senador	3	35.2
	Pinorsigue	18	33.3
	Dali	19	28.9
	Maginsalay	3	28.3
Sto. Domingo	Senador	12	34.2
	Maginsalay	3	33.4
	Dali	72	31.0
Both Barrios	Senador	15	34.3
	Pinorsigue	18	33.3
	Maginsalay	6	30.7
	Dali	91	30.3

[a] Farms reporting one variety each only, a total of 130 farms.

TABLE 14.—*Farm inventory*

	PESOS		PER CENT	
	1954-55	1956-57	1954-55	1956-57
Land	1,371	1,346	65	67
Dwelling	458	353	21	18
Other buildings	25	19	1	1
Work animals	181	159	8	8
Other livestock	59	65	3	3
Tools, equipment and supplies	40	54	2	3
Total [a]	2,134	1,996	100	100

[a] The difference in total peso value is not significant at the 5 per cent probability level ($t = 1.195$). The peso value have not been adjusted for any change in price level and therefore the difference may reflect only price changes.

The difference in total inventory between two years was small. The largest change among inventory categories was in dwelling. This, however, might reflect the differences in the farmers' estimates for the two years.

Measures of income. The traditional approach in farm business analysis consists in allocating to certain production factors a fixed amount, and then alloting the residual return to one factor which is chosen to be the criterion of profitability. Labor income, for example, is one of the most commonly used measures in farm management

analyses. The factors that are paid first in this case are land, buildings, work animals, tools, equipment, supplies, hired labor, and family labor (other than that of the operator). The residual then represents the earnings of the operator's labor or the operator's *labor income.*

Farm Receipts consist of the value of crops sold or to be sold, value of crops to harvesters and threshers (and to landlords in case of tenant farms), livestock and livestock products sold, any other farm asset sold, and increase in inventory. Farm receipts were lower in 1956-1957 than in 1954-1955 by ₱24 for the total farm. The difference is not statistically significant however (table 15).

TABLE 15.—*The farm businesses*

	FARM		LANDLORD		OPERATOR	
	1954-1955	1956-1957	1954-1955	1956-1957	1954-1955	1956-1957
Farm receipts	212	188 [a]	57	59	155	129
Farm expenses	190	213 [a]	10	13	180	200
Net farm income	22	–25 [a]	47	46	–25	–71
Interest on investment (12%)	258	239	—	—	210	182
Labor income	–236	–264 [a]	—	—	–235	–253
Value of operator's labor	114	91	—	—	114	91
Returns to capital	–92	–115	—	—	–139	–162
Value of farm privileges	—	—	—	—	205	194
Operator's farm labor earnings	—	—	—	—	–30 [a]	–59
Value of unpaid family labor	—	—	—	—	45	36
Family farm labor earnings	—	—	—	—	15	–23
Other incomes	—	—	—	—	532	431
Family income from all sources	—	—	—	—	547	408

[a] Difference between two years not significant at the 5 per cent probability level.

Farm expenses include hired man labor, hired animal labor, value of unpaid family labor, value of the shares paid to harvesters and threshers, and any such purchases for the farm such as tools, equipment and supplies. Farm increased from ₱190 in 1954-1955 to ₱213 in 1956-1957. The difference of ₱23 is not significant.

The Net Farm Income is the first measure of farm profits; it is the difference between the Farm Receipts and the Farm Expenses. This measure is best used in big commercial farms. It is used here, however, as a necessary step for further computations of other meas-

ures in small farm businesses. Net Farm Income decreased from ₱22 in 1954-1955 to − ₱25 in 1956-1957. The difference of ₱47 is not significant.

Labor Income is the remainder after the interest to average inventory (12 per cent in this study) is subtracted from the net farm income. It represents the amount alloted to the operator's labor. Labor Incomes were negative for both years. A deficit of ₱28 more was incurred in 1956-1957 than in the first study year. This means that if all the other factors of production including the investment (at 12 per cent were to be paid first, there would be nothing to allocate to labor. In fact, there would not be enough Net Farm Income to pay for the investment.

Returns to Capital were likewise negative for both years. A deficit of ₱23 more was incurred in 1956-1957 compared to the first study year. This means that if all the other factors of production, including the operator's labor were accounted for, nothing would be left to allocate to the investment. Analogous to the case of labor income, the Net Farm Income would not be sufficient to pay for all the factors of production aside from the investment.

The preceding discussion dealt with the farm as a whole. Inspection of the landlord's position showed that his farm receipts increased by two pesos. His farm expenses, however, increased too and by more than the increase in receipts. Thus, he had a decrease of ₱1 in his net farm income. This figure also represents his returns to capital inasmuch as he had no labor inputs in the farm business.

The Farm Receipts, Net Farm Income, and Labor Income were not as meaningful as the labor earnings. The products used at home were as much a part of receipts as the products sold but yet were not considered except in Labor Earnings. The Operator's net farm income would have been positive if the value of farm privileges were considered in farm receipts.

All the measures of income were lower in 1956-1957 than in 1954-1955. The operator's farm labor earnings had a difference of ₱29. This difference was not significant at the 5 per cent probability level.

It may be pointed out that the farm expenses increased. One item that surely contributed to the increase in expenses was the amount paid for irrigation. This was not a part of the farm business

picture in 1954-1955 that it was for 1956-1957. One-tenth of the crop was charged for irrigation. The average amount, 1.4 cavans per hectare, was less than the yield increase, 3.9 cavans (table 16).

TABLE 16.—*Rice yields and quantity paid for irrigation*

	CAVANS OF RICE		
	Per ha. yield	Yield increase	Paid for irrigation
La Purisima			
1954–1955	22.2	—	—
1956–1957	26.2	4.0	1.2
Sto. Domingo			
1954–1955	26.9	—	—
1956–1957	30.7	3.8	1.7
Both Barrios			
1954–1955	24.2	—	—
1956–1957	28.1	3.9	1.4

The expectations would be for the measures of farm income to increase after knowing that the yields of rice, the most important enterprise on the farm, had increased. The analysis of the farm business, however, showed the contrary. The first possible explanation for this was the change in the price of rice. Both the weighted and unweighted average decreased in 1956-1957 (table 17).

TABLE 17.—*Prices of palay*

	UNWEIGHTED		WEIGHTED [a]	
	1954-1955	1956-1957	1954-1955	1956-1957
	pesos per cavan			
La Purisima	7.07	6.64	7.55	6.63
Sto. Domingo	7.01	6.62	7.07	6.24
Both Barrios [b]	7.04	6.63	7.31	6.45

[a] Weighted by the production per farm.
[b] The difference for both barrios in the unweighted average is significant at the 10 per cent probability level.

The difference of incomes between the two study years would become smaller or the incomes would almost equal if the same price of rice were used in the analysis of the two business years. The conclusion therefore would be that irrigation had no effect on the returns to the factors considered in this approach.

SOME PROBLEMS OF THE IRRIGATION PROGRAM

Mention has been made earlier about the suspension of the operations of the irrigation system. Problems and difficulties were thus canvassed to ascertain which could explain the suspension of the operations of the irrigation system. Some were listed by the administrator of the ISU.[5] The problems observed in the study areas, including those of four other projects, were comparable and may be grouped into two: the physical and the human factors.

The Physical Factors

Soil drainage, topography and climatic factors are the major physical factors which may inhibit the efficiency of an irrigation system. The survey of ISU done prior to the approval and subsequent installation of a pump irrigation system considered the above-mentioned factors, particularly soil drainage and topography.[6] Climatic factors may not have received due attention, yet they are important.

Droughts. The low rainfall months compose the dry season, i.e., January through May in the Sto. Domingo-La Purisima area. The farmers do not plant rice during this period. This was the fundamental reason for establishing an irrigation system. The effect of dry season or drought was illustrated when 53 farmers planted 38.1 hectares with rice during the dry season of 1956-1957. The farmers were relying on the irrigation system but unfortunately the system, as mentioned earlier, was not put into operation. The result was that only 10 farmers out of 53 harvested 10.9 out of the 38.1 hectares planted (table 18).

TABLE 18.—*Destruction from droughts on 53 rice farms*

	PLANTED	HARVESTED
Farms	53	10
Hectares	38.1	10.9
Cavans yield per hectare	—	20.8

The successful operation of an irrigation system depends largely on abundant water supply. The Sto. Domingo-La Purisima irrigation system did not have any trouble with inadequate supply of

[5] Annual Report of the Administrator of the Irrigation Service Unit for the year ending June 30, 1957 (Manila, 1957), pp. 14-16.
[6] Irrigation Service Unit, *op. cit.*

water since its source of water, the Bicol River, does not get exhausted.

Floods. The high rainfall months compose the wet season, i.e., June through December. Too much rainful during this period may cause floods and become an obstacle to irrigation. Canals and dikes may be destroyed and the crop wiped out.

Floods have been reported by the farmers to occur during the months of July to February especially September, October, November, and December (table 19).

TABLE 19.—*Farmers reporting floods in the La Purisima–Sto. Domingo area for specified months*

MONTH OF FLOOD	FARMERS REPORTING [a]		
	La Purisima	Sto. Domingo	Both Barrios
July	1	—	1
August	9	2	11
September	13	10	23
October	6	7	13
November	12	23	35
December	22	35	57
January	1	7	8
February	1	—	1

[a] Some reported floods to occur in more than one month.

The effect of floods on rice crops can be illustrated by the number of farmers reporting destruction of their crops in 1956-1957. It was difficult to gauge how much of the crop was destroyed by floods, so that the question was posed to the farmers with the expected answer of either total, partial, or no destruction. Seven farmers reported total destruction; 46, partial; and 25, no destruction (table 20).

TABLE 20.—*Farmers reporting destruction from floods in the La Purisima–Sto. Domingo area*

	FARMERS REPORTING		
	La Purisima	Sto. Domingo	Both Barrios
Total destruction	3	4	7
Partial destruction	31	15	46
Not affected	10	15	25
No report	36	62	98
Total	80	96	176

The degree of destruction varied from slight to heavy. It was difficult to ascertain how much destruction was there for the partial, hence, those reporting different degrees of destruction were all classified under partial. Ninety-eight farmers who did not know whether the floods caused destruction on their crops were classified under the "no report" group.

Floods may either delay planting or destroy standing crop. If planting is delayed, the growing period of the crop will be extended into the low rainfall months. Irrigation may serve to supplement the water in this case. On the other hand, irrigation may be used also to help prepare the land and plant early to avoid the floods later.

The Human Factor

The human element is the vital determinant of success in any endeavor. This plays an important role in the pump irrigation program of ISU where groups of people are concerned because it is a co-operative venture.

The President-Project Manager of the Sto. Domingo-La Purisima Irrigation Association enumerated the problems and difficulties in administering the system. These included right-off-way troubles, partial or non-payment of dues, non-attendance in meetings, and general non-cooperation of members.

Some farmers who were near the canals would not let the water pass over to their neighbor's fields.

Some under-reported their harvest. Since the charge for the use of irrigation was based on the harvest, those farmers paid only a part of their dues. Other farmers claimed not having used irrigation water so that they did not pay. Two questions are involved here. Did not these farmers use irrigation water? If not, why? The answer to the second question may yet determine whether one may be held responsible for supporting the irrigation system whether or not he used irrigation water.

Non-attendance of meetings is a common attribute of rural people. This is a limitation in any cooperative endeavor. Those who do not attend meetings do not help formulate plans. They are the last to understand, if at all, what is going on and they are the first to criticize, usually adversely.

Members can be responsible and cooperative in ways other than being present in meetings. An example would be adherence to the

agreement; for instance not to allow their carabaos to pass across a canal without a bridge (which is provided in particular places only). Destroyed canals means less efficient water traffic and more repair expense.

The failure of cooperative undertakings may not all be ascribed to the members. Management may have an equal share in the blame, if not more.

The President-Project Manager of the Sto. Domingo-La Purisima project seemed to be the sole administrator and policymaker. He claimed that even his co-officials were uncooperative.

Inefficiency of management may be roughly indicated by various criteria. The keeping of records is one. Records of associations visited were unsatisfactory.

Organizing the staff may also indicate how sound the policy of management is. The staff of the Sto. Domingo-La Purisima irrigation project had for the first season of operation a 17-person staff. In a meeting in February 16, 1957, it was resolved that thenceforth the staff shall consist of six only—one project manager, one bookkeeper, one mechanic, and three water tenders.

The reduction in the staff certainly depicts one costly error, i.e., employing more than is necessary. With this statement, goes the conclusion that the first staff was not fully employed throughout the year. It can only be conjectured whether there were provisions concerning the question when to work and when to receive pay. The report that some water tenders did not turn in all their collections may be mentioned here: they took it upon themselves to deduct their salaries from their collections.

The problems discussed above do not exhaust the possibilities among the different projects but they illustrate how the entire program can fail. These problems are recognized by authorities on group activities.[7] They are problems not only of the pump irrigation program, but of any cooperative venture. These problems have to be solved or minimized before the effects of a program, such as the pump irrigation, may be fully realized.

[7] H. H. Bakken and M. A. Schaars, "The Economics of Cooperative Marketing," McGraw-Hill Book Company, Inc., New York, 1937.

DEVELOPMENT OF IMPROVED MERCHANDISING PRACTICES FOR VEGETABLES [1]

VICENTE U. QUINTANA [2]

In shipping lettuce in bamboo baskets from Baguio to Manila, it lost up to 3 per cent of its initial weight. Other losses like trimmings, damage due to rough handling may raise the total loss to 29 per cent. On the other hand, except for trimmings, there was no loss from lettuce shipped in wooden crates.

The transportation cost of trimmings from untrimmed lettuce shipped to Manila in crates was ₱0.0070 per kilo of initial weight, while that of trimmings from similar materials shipped in bamboo baskets was ₱0.0085.

Marketing, one of the more important activities in Philippine economy, has received very little attention during the past years. As a result, the marketing practices that were used five, ten or even more years ago are still being used today. The urgent need of improving the present practices calls for quick action to develop the system together with other aspects of the economy.

Most of the farm products are channeled from the producer to the consumer without help of proven merchandising techniques such as grading, packaging, and brand labeling. These result in many inefficiencies in the retail phase of marketing and prove to be detrimental to both producer and consumer. From the retailer's viewpoint, effective merchandising is important because it lowers costs which gives impetus to his business and increases his income. On the other hand, to the consumer, merchandising is important because it provides him with the kind of food wanted and service desired. Effective merchandising has far-reaching effects. Robert M. Walsh [3] stated that product innovation is one of agriculture's most vital weapons in competing for its share of the consumer's dollar. It adds a spark to agricultural marketing, producing new

---

[1] Central Experiment Station Contribution No. 2014. Part of Project No. 1123.

[2] The author wishes to thank Dr. Lawrence B. Darrah, Cornell Visiting Professor, for his advice and Dr. Horst von Oppenfeld, Visiting Professor, Prof. Pedro R. Sandoval and Mr. Fabian A. Tiongson for their valuable suggestions.

[3] R. M. Walsh, "New Packaging Spark for Farm Products," *Agricultural Marketing* (January, 1958).

demands for farm products and further gains in standard of living.

This vegetable experiment was conducted in La Trinidad Valley, Mountain Province and Manila in cooperation with the Mountain Province Federation of FaCoMas, to compare the efficiency of the wooden crates and bamboo baskets, and to improve the marketing of vegetables.

Containers. In the marketing of vegetables, three types of containers are used. The containers commonly used are the large woven baskets that are used for cabbage and wong-bok. Usually, the price paid for this container is ₱1.00. Lettuce is packed in baskets that hold 30 to 35 kilos. The prevailing price for these baskets is about ₱0.80. The third type of basket is for beans and other small vegetables. In general, the baskets are "one-way, one-use deals." They are cut apart or destroyed by the wholesalers or retailers after the shipping.

One of the hindrances the containers offer is their large size. It makes them difficult to handle easily and efficiently. Many of the baskets in which the vegetables are shipped hold 30 to 100 kilos. Obviously, these are too heavy for the average Filipino to handle. Many instances have been noted where loaded crates were dropped from truck bodies to the ground resulting in heavy damage. Another hindrance is the pliability of the baskets. It does not give the vegetables enough protection.

This is aggravated by the way the containers are handled and loaded. The bamboo baskets are fairly sturdy in upright position. However, the truckers lay them on their sides with other baskets piled on top of them. Considerable crushing of the produce occurs. The sharp edges of the baskets cut and bruise many leaves and stalks, and losses are increased. Trucking companies load the vehicles as heavily as possible to increase their income but this only increases the amount of damage. The fact that trucking companies assume no liabilities for damage further encourages little care during transportation.

Another questionable practice is the selling of all vegetables by weight rather than by the head or the stalk. In selling by weight, producers do not want to trim even the waste parts from the vegetables. They want as much weight as possible to be included. The

fact that this waste is paid for and has a transportation charge means that costs are unnecessarily increased.

Lettuce Crating Experiment. In an effort to determine whether rigid crates made of wood might provide more protection to the vegetables than bamboo baskets, the Department of Agricultural Economics designed and built a wooden vegetable crate and tested it through shipping experiments. Lettuce was shipped soon after harvest in bamboo baskets and in wooden crates.

In the shipping experiment from Baguio to Manila, the lettuce in bamboo baskets lost one kilo or 3 per cent of the initial weight. On the other hand, there was no loss of weight for the lettuce in

TABLE 1.—*Comparison of the use of bamboo baskets and UPCA experimental crates for lettuce*

CONTAINER	REGULAR BAMBOO BASKETS	WOOD CRATES	WOOD CRATES
1. Form of lettuce	No trimming at harvest	No trimming at harvest	Field trimmed
2. Weight of container	2.5 kilos	3.5 kilos	3.5 kilos
3. Net weight of lettuce in Trinidad Valley	33.0 kilos	21.0 kilos	20.0 kilos
4. Net weight of lettuce upon arrival in Manila	32.0 kilos	21.0 kilos	20.0 kilos
5. Loss en route to Manila	1.0 kilo	none	none
6. Net weight of lettuce when trimmed for retail sale	25.0 kilos	16.1 kilos	19.5 kilos
7. Loss in retail trimming			
Quantity	7.0 kilos	4.9 kilos	.5 kilo
Per cent	22 per cent	23 per cent	2.5 per cent
8. Net weight of lettuce when delivered to buyer	23.5 kilos	16.1	19.5
9. Loss in weight overnight			
Quantity	1.5 kilos	none	none
10. Total loss:			
Quantity			
Transit	1.0 kilo		
Trimming	7.0 kilos	4.9 kilos	.5 kilo
Overnight	1.5 kilos		
Total	9.5 kilos	4.5 kilos	.5 kilo
Per cent	29%	23%	2.5%
Value @ ₱0.80	7.60	3.92	.40
11. Transportation cost per kilo of initial weight	.0085	.0070	.0075

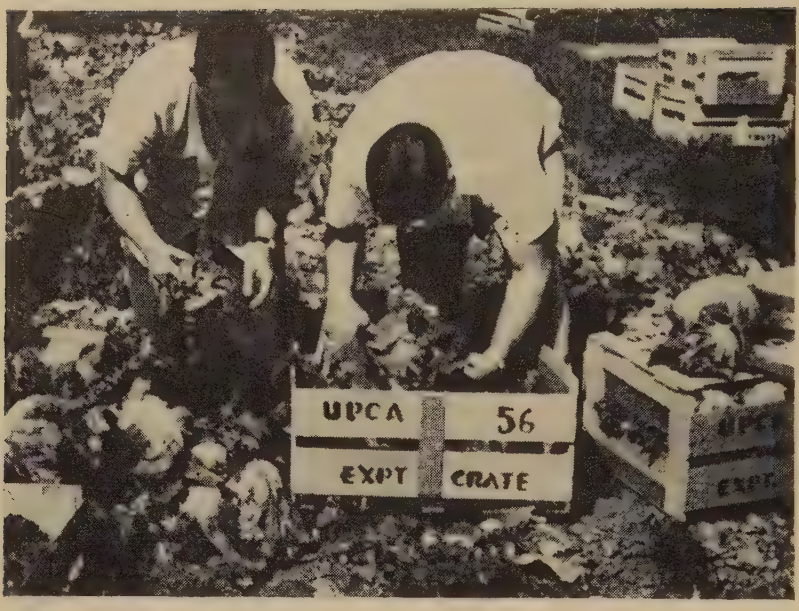

Fig. 1.—Packing Lettuce in Experimental Crates.

Fig. 2.—Weighing the Vegetables.

the wooden crates for both trimmed and untrimmed vegetables (table 1). The loss from trimming for retail sale was approximately the same for the untrimmed lettuce in both the bamboo baskets and wooden crates. With the field-trimmed lettuce where the waste was left on the field, there was only a small amount of trimmings. The lettuce was stored overnight in Manila and more reduction in weight occurred for the lettuce in bamboo baskets than for that in wooden crates. The added overnight loss amounted to 1.5 kilos. The total loss incurred from the time the lettuce in bamboo baskets left the farm until it reached the retailers in Manila amounted to 2½ kilos. For the lettuce in the crates, there was no loss other than necessary trimming. In the second shipping experiment of lettuce together with wong-bok and celery, the lettuce in wooden crates incurred only a loss of less than 2 per cent. With untrimmed heads in bamboo baskets, the loss was almost 4 per cent.

The transportation cost for the waste products to Manila amounted to ₱0.15 for untrimmed lettuce in crates and ₱0.28 for untrimmed lettuce in bamboo baskets. With the field-trimmed lettuce in crates, there was practically no cost for shipping wastes.

There was a marked difference in the conditions of the lettuce upon arrival in Manila. The outer leaves of lettuce in bamboo baskets were severely damaged. The appearance was poor and water dripped from the bottom of the baskets. The lettuce shipped in wooden crates was in excellent condition. Little or no damage occurred to the outer leaves.

Wong-bok and Celery Crating Experiments. The wong-bok in both containers was untrimmed. The vegetables in bamboo baskets lost more weight percentagewise than those in wooden crates. However, the difference due to the crushing of the leaves and stalks was not very significant.

The topped celery in the especially designed wooden crates had a loss significantly smaller than the percentage loss of the celery in the bamboo baskets. This marked difference was the result of the heavy damage of the celery tops in the bamboo baskets. On the other hand, the celery in the wooden crates was excellent.

Transportation. Truck is the most important means of transporting vegetables from La Trinidad Valley to Baguio. One-way travel cost the producer ₱0.10 fare plus ₱0.10 per basket freight. If the vegetables were for the Baguio public market, the farmers

have to hire boys with push carts to deliver the vegetables to the retail stalls at ₱0.05 per basket.

TABLE 2.—*Decrease in weight of vegetables in different containers during transit, Manila 1957*

VEGETABLE	CONTAINER	TREATMENT	INITIAL WT.	ARRIVAL WT.	DIFFERENCE	PERCENTAGE LOSS
Wong-bok	Crate	Untrimmed	22.2	21.5	.70	2.9
	Basket	"	78.8	76.3	2.50	3.1
Lettuce	Crate	"	19.8	19.0	0.80	4.0
	"	Partly trimmed	17.0	16.3	0.70	4.0
	"	Retail trimmed	19.0	18.7	0.30	1.6
	Basket	Untrimmed	28.0	27.0	1.00	3.6
Celery	Crate	Toptrimmed	15.3	15.0	0.30	1.9
	Basket	Untrimmed	30.5	29.7	0.80	2.6

Vegetables for the Manila markets are all shipped by trucks. The trucks usually leave Baguio in the afternoon. The time required to move vegetables from Baguio to Manila is more or less 5 hours. There are two transportation rates depending on the route taken. Via the Kennon Road the cost amounts to ₱0.03 per kilo; via the Naguilian it is ₱0.02 per kilo. The difference in the rate is due to the toll charge in Kennon Road. Only small cargo trucks pass the short route.

Prices and Margins. To obtain accurate prices and margins for the marketing of vegetables is rather difficult. Farm prices, retail prices, and transportation costs are accurately gathered, but the shift in price of the vegetable between the farmer and the retailer is difficult to determine.

Prices and margins for the selected vegetables were gathered as of March, 1958. Cabbage price at the farm was ₱0.27 per kilo. Transporting it to Manila cost ₱0.03 per kilo which is paid for by the wholesaler. The wholesaler's paying and selling prices were ₱0.30 and ₱0.35 per kilo, respectively. Considering the fact that cabbage is a hard compact vegetable that incurs little damage, one expects a retail price of about ₱0.50 per kilo. The expected retail selling price of cabbage was its actual selling price (table 3).

Not so with wong-bok, lettuce, and celery. The expected selling price which is the sum of the farm price, transportation cost, and the first wholesaler's margin was substantially lower than the

actual retail prices. For example, the expected retail selling price of lettuce was ₱0.60 but the actual selling price was ₱1.00 per kilo. This may be explained by a substantial amount of wastage. It has been observed that many heads of lettuce and stalks of celery at retail are only half the size of those coming from the farm. A substantial price increase must have then occurred to cover the losses due to shrinkage.

TABLE 3.—*Approximate prices for selected vegetables, Manila, March, 1958*

ITEM	LETTUCE	CABBAGE	CELERY	WONG-BOK
		pesos per kilo		
Farm price	.25	.27	.40	.30
Transportation to Manila	.03	.03	.03	.03
Wholesaler paying price	.28	.30	.43	.33
Wholesaler selling price	.30–.35	.35	.50	.35–.38
Expected retail selling price	.60	.50	.60–.70	.50–.60
Actual retail paying price	.80	.35	1.00	.80
Actual retail selling price	1.00	.50	1.20	1.00

Consumer Buying Habits. Of the customers observed, nearly 90 per cent studied the lettuce display carefully before buying. Female customers were observed to study them more closely than did the male customers. Twenty-two per cent of the male customers bought without hesitation as compared with only 7 per cent of the female customers. More than 80 per cent of the female customers handled the lettuce but only about 50 per cent of the male customers did.

Many weighed the lettuce before deciding to buy the heads: almost two-thirds of the female customers and one-third of the male. The practice of removing the outer leaves was followed by one out of every five customers of both sexes.

Regardless of sex, most of the lettuce customers bought for their own consumption. However, a sizeable number were buying for other persons. Male and female customers observed, indicated a preference for buying lettuce by weight rather than by head, apparently because they are used to this method (table 4).

Size of Purchase. Based on observations made of 198 lettuce customers, the average purchase of lettuce was 1.9 heads (table 5). Before this was finally purchased, the customers handled an average

of nearly 3 heads per individual. Although the lettuce heads had already been retail trimmed, the customers removed an average of one leaf per head of lettuce bought. Female customers handled more heads in making their purchase, but male customers were more strict in removing wasted leaves. The removal of outer leaves leave no protection to the inner leaves and should be discouraged. However, at the store it means that the weight of lettuce is reduced with the result of prices being increased to compensate for such loss since the leaves removed were paid for by the retailers from the wholesalers.

TABLE 4.—*Behavior of 198 customers in choosing lettuce*

BEHAVIOR		MALE	FEMALE	COUPLE MALE & FEMALE	TOTAL
				per cent	
No hesitation		22	7	25	11
Studied heads		78	93	75	89
Handled the heads:	Yes	54	84	75	77
	No	24	9	—	12
Weighed the heads:	Yes	27	61	50	51
	No	51	32	25	38
Removed leaves	Yes	20	23	25	22
	No	58	70	50	67
Buying for:	Self	78	99	100	95
	Others	24	99	—	19
Prefer to buy:	Head	22	22	—	20
	Kilo	76	77	100	78
	Other	2	1	—	2

TABLE 5.—*Characteristics of 198 lettuce customers and of their purchases, Manila, 1958*

ITEM	MALE	FEMALE	COUPLE MALE & FEMALE	TOTAL
Number of customers	41	153	4	198
Average age	35	35	36	35
Heads bought per customer	2.2	1.8	1.3	1.9
Heads handled	2.1	2.8	4.0	2.6
Leaves removed from heads bought	1.4	.5	.2	.7

Appraisal and Recommendations. The big losses incurred from the time vegetables leave the farm up to the final consumer can only mean marketing inefficiency. The experiments revealed that the

current vegetable containers and the system of loading are the main causes of heavy damage. This can be minimized by using another container which will give the vegetables ample protection. The wooden crates used in this experiment proved to be more efficient than the bamboo baskets. The vegetables in these crates arrived in Manila in better condition.

Another solution to this problem is to have an insurance system in transporting the vegetables. In this case, the transportation agency will be liable for any damage done while the vegetables are in transit. Together with this recommendation, since injury is being minimized, the vegetables should be retail trimmed at the farms. The trimmings will be left on the farm and used as fertilizer. This, in effect, will reduce the total cost of transportation and at the same time utilize low cost farm labor.

NOTE: SPORE TRAPPING EXPERIMENTS WITH *ALTERNARIA PORRI* (ELLIS) CIF. AND *ERYSIPHE POLYGONI* DC.

In the control of fungus diseases a knowledge of the time when plant parasitic fungi release their spores is imperative in determining the time the spray-chemical should be applied to afford a maximum protection.

One of the five methods given by Pyenson [1] (1951) in the control of plant diseases is by protection. This means the placing of some protective barrier, chemical or physical, between the susceptible organ of the host plant and the inoculum of the disease-producing organisms so that the pathogen will be killed before it can invade the host tissue. He stated further that no matter how effective the spray-chemical is, it may be worthless if application is not properly timed.

Horsfall [2] in 1956 gave two rather different procedures to achieve protection with fungicides. First, the fungicide is aimed to seek out the fungus at rest either before or after the fungus has reached the host, and secondly, the fungicide is applied as a stationary layer on the outside of the host, there to lie in wait for the mobile fungus. It is therefore very important that the chemical protectant should be applied much ahead of the fungus if a satisfactory control is desired.

In the control of plant diseases by protective sprays, knowledge of the time and conditions under which the parasitic fungi shed their spores is important in timing the spray applications. To gather preliminary information on spore-shedding, two experiments on spore trapping were conducted. The first experiment was conducted in Bo. Caanawan, San Jose, Nueva Ecija from February to March, 1959. An onion field, about 4 $\times$ 10 meters showing severe infection with purple blotch *Alternaria porri,* was selected.

---

[1] Louis L. Pyenson, "Elements of Plant Protection," John Wiley and Sons, Inc., New York, 1951, 538 p.

[2] James G. Horsfall, "Principle of Fungicidal Action," Chronicle Botanica Co., Waltham, Mass., U.S.A., 1956, 279 pp.

Glass slides smeared with petrolatum on one side were used to trap the spores. Each slide with the smeared side up was placed on a slide holder nailed on top of a bamboo peg which was driven in the soil about one-half of the height of the onion plants. Ten slides were equally distributed at random in the forty-meter square area and exposed for thirty minutes. Three exposures were made: 8:30 a.m., 1:30 p.m. and 4:30 p.m. The wind velocity and temperature in the field were recorded for each exposure. All necessary precautions to prevent possible access of spores before and after exposures were observed.

A microscope equipped with a mechanical stage was used for examining the slides. The low power objective was used for counting the spores on each slide.

Experiment 2 was carried out in Mountain National Agricultural School in Trinidad Valley, Mountain Province, from March to June, 1959. The field selected was planted with peas which was severely affected by powdery mildew, *Erysiphe polygoni* (fig. 1).

The spore-trapping was conducted in the same way as in Experiment 1 only with a little modification in the laboratory. Instead of examining the entire slides thoroughly, only two one-square centimeter areas were examined on each slide. This method was adopted because there were too many spores trapped. In the first trial a single slide had as many as 8 to 10 thousand spores. To make the work still easier, but the results reliable, a clean white thick paper was cut to exactly the size of the glass slide. On this paper two 1-sq. cm. areas were cut out. It was then placed at the back of the slide and fastened firmly with scotch tapes. Only spores in the 1-sq. cm. areas were counted under the low power objective of the microscope. The number of spores recorded was the total of the two 1-sq. cm. areas for each slide. The same paper was used in all counting.

RESULTS

The results of experiment 1 (table 1) show that the spores of purple blotch fungus were liberated most abundantly at noon with an average of 227 spores per slide (2.5 $\times$ 7.5 cm.) at a temperature of 34°C. An average of 117 spores per slide were trapped in the afternoon at a temperature of 32°C. Only 29 spores per slide were trapped in the morning exposure at a temperature of 27.2 C. Wind velocity did not seem to show any influence on spore liberation.

Fig. 1.—Powdery mildew of peas. Note the white powdery masses covering the entire leaflets. (*Photograph taken by the junior author.*)

TABLE 1.—*Average number of spores of Alternaria porri trapped in petrolatum-smeared slides*

TIME EXPOSED	TEMPERATURE °C.	WIND VELOCITY *miles/ hr.*	MEAN NUMBER [a] OF SPORES
8:30–9:00 a.m.	27.2	3.34	29
1:30–2:00 p.m.	34.0	3.00	227
4:30–5:00 p.m.	32.0	4.50	117

[a] For three trials.

The data from experiment 2 (table 1) show a remarkable similarity to the results obtained in experiment 1 in spite of the differences in plant pathogen, host, and climatic conditions. The morning

exposure had the least number of spores and the noon exposure, the most.

TABLE 2.—*Average number of spores of Erysiphe polygoni trapped in petrolatum-smeared slides*

TIME EXPOSED	TEMPERATURE °C.	WIND VELOCITY *miles/ hr.*	MEAN NUMBER [a] OF SPORES
7:30–8:00 a.m.	19.3	1.75	107
1:30–2:00 p.m.	28.0	1.88	3,694
6:00–6:30 p.m.	18.0	4.62	1,585

[a] For three trials.

From these data, the suggestion may be made that morning application of fungicides would be advantageous on two counts: (1) it would anticipate the big release of spores at noon, hence afford the plant sufficient protection and (2) because of the generally lower win velocity, spray drift will be less in the morning.

—*R. V. Alicbusan, L. A. Schafer, and B. A. Revilla*

NOTE: CYTOLOGY OF PHILIPPINE PLANTS I. *AVERRHOA BILIMBI* LINN.

The cytology of most Philippine plants, especially the less commercially important ones, has not yet been studied. Cytological analyses of these plants will provide useful information to plant breeders because the improvement of crops through hybridization is not confined within the species; it may be between species, genera or even families.

In making distant crosses the chromosome number should be taken into consideration. The chances of success in crossing is greater when it is between species of the same chromosome number or when one is polyploid of the other, than when it is otherwise. With cytological studies it may be found that some species are polyploids of other species and this is of importance in the production of seedless fruits of plants where the seeds are not desired. A tetraploid crossed to a diploid will produce a triploid, a highly sterile plant. If the fruits of this plant can develop through parthenocarpy, which is common among triploids, seedless fruits may be had.

1. *Averrhoa bilimbi* Linn. No cytological study of *Averrhoa bilimbi* Linn., locally known as *kamias* has been reported. The only cytological work done on the genus *Averrhoa* is on *A. carambola* Linn. (balimbing) which was reported to have a somatic chromosome number of 24.[1]

Sporocytes were collected from *A. bilimbi* trees and were fixed in Farmer's fluid (1:3 acetic-alcohol mixture). The sporocytes were fixed for six to 12 hours and then stored in 70 per cent alcohol.

The smear technique was used in the cytological studies of the pollen mother cells. Chromosome counts were made at diakinesis and at Metaphase I. The morphology of each chromosome was studied at pachynema. Camera lucida drawings of the different meiotic stages as well as the invidual chromosome at pachynema were made.

OBSERVATIONS

Normal meiotic behavior of the chromosomes was observed in all the samples examined (figs. 1a to 1k). Cytokinesis was observed

[1] C. D. Darlington and A. P. Wylie, "Chromosome atlas of flowering plants," The MacMillan Co., New York, p. 197, 1956.

to occur after the second division (fig. 1j). The chromosome count of the sporocytes from the different sources was the same, n = 12 (fig. 1b).

Fig. 1. Camera lucida drawings of the different vierotic stages of *A. bilimbi* sporocytes.
a—pachynema; b—diakinesis; c—metaphase I; d—anaphase I; e—tetophase I; f—panophase II; g—metaphase II; h—anaphase II; i—telophase II; j—cytokinesis; k—tetrads; l—pollen grains.

In the study of the chromosome morphology, only the location of the centromere and the presence of knobs were determined (fig. 2). Detailed examination of the chromosome was not possible with the techniques and microscopes used in this study, aside from the fact that the chromosomes were relatively small.

The 12 chromosomes are tentatively designated by numbers 1 to 12. Of the 12 chromosomes of *A. bilimbi,* six have median centromere, namely, chromosomes 4, 5, 8, 9, 10 and 11. The rest have sub-median constrictions.

Four chromosomes do not have knobs, five have one each, one has two knobs and two have three knobs each. The four chromosomes without knobs are 3, 8, 9, and 12. Those with one knob each

are divided into three sub-groups, namely: that with the knob at the terminal portion of one arm (chromosome 10), those with subterminal knobs (chromosomes 5 and 11), and those with the knobs at the mid-point of the long arm (chromosomes 4 and 7). Chromosome 2 has two knobs both of which are on the long arm. Chromosomes 1 and 6 have three knobs each, two of which are on the long arm and one on the short arm.

The nucleolus organizer was observed to be chromosome 5.

—*Dolores A. Ramirez*

Fig. 2.—Camera lucida drawings of the 12 chromosomes of *A. bilimbi* at pachynema

PAUL WORK *

WHEREAS, In the death of Professor Paul Work the agricultural profession has lost a tireless worker, a prolific writer, a sympathetic teacher and friend, and a true Christian gentleman; and

WHEREAS, He made numerous outstanding contributions to the vegetable industry through many years of service, his keen reports in the trade journals and his long interest in and encouragement of variety testing and improvement; and

WHEREAS, During his tenure as visiting professor in the College of Agriculture, he laid the foundations for an increased teaching program and initiated a variety testing project; now therefore be it

RESOLVED, that the faculty of the College of Agriculture of the University of the Philippines, hereby express its feeling of grievous loss and extend to his widow and children its expression of deep sympathy; and be it further

RESOLVED, that copies of this resolution be spread in the minutes of the faculty of the College of Agriculture and sent to the archives of the University, and that they be published in *The Philippine Agriculturist.*

* Resolution passed by the Executive Committee in its meeting on August 22, 1959.

THE CENTRAL EXPERIMENT STATION

LIST OF AVAILABLE PUBLICATIONS

No. 2.—Bud Rot of Coconut ..... *By G. O. Ocfemia*

No. 8.—Horse Breeding in the Philippines ..... *By V. Villegas*

No. 11.—The New College Copra Drier ..... *By Moises M. Kalaw* (Revised)

No. 16.—A Simple Farm Record for the Farmer .. *By F. M. Sacay*

No. 17.—College Trapnest ..... *By F. M. Fronda and P. S. Paje*

No. 18.—Surveying for Area with a Surveyor's Staff ..... *By Alexander Gordon*

No. 24.—Construction and Operation of Silos in the College of Agriculture ..... *By J. P. Esguerra*

No. 27.—Bunchy-Top of Abacá ..... *By G. O. Ocfemia*

No. 29.—Collegiate Education in Agriculture ..... *By Leopoldo B. Uichanco*

No. 30.—What Should Filipino Ornamental Gardens and Ornamental Plants Be? ..... *By N. B. Mendiola*

No. 33.—Kenaf Culture ..... *By P. A. David*

No. 34.—Vanilla Culture ..... *By P. A. David*

No. 35.—Black Pepper Culture ..... *By P. A. David*

The price of the circulars listed above is thirty centavos (₱0.30) each.

All orders for circulars with payment should be addressed to the Business Manager, THE PHILIPPINE AGRICULTURIST, College, Laguna, Philippines.

PHILIPPINE AGRICULTURE, Volume 2 { Clothbound ..... ₱7.50; Postage 0.40

Central Experiment Station Bulletin 1 ..... ₱1.00

All orders for books with remittance should be addressed to

THE DEAN AND DIRECTOR
COLLEGE OF AGRICULTURE AND
CENTRAL EXPERIMENT STATION
COLLEGE, LAGUNA, PHILIPPINES

The Philippine Agriculturist

(Formerly The Philippine Agriculturist and Forester)

Published by the COLLEGE OF AGRICULTURE
AND CENTRAL EXPERIMENT STATION
UNIVERSITY OF THE PHILIPPINES

Vol. I—2

Vol. II—4, 5, 6

Vol. IV—3, 5-6, 7

Vol. V—5, 8, 9, 10

Vol. VI—1, 4, 5-6, 7, 8, 9, 10

Vol. VII—1, 2, 3, 4, 5, 7, 8

Vol. VIII—3, 4, 5, 10

Vol. IX—3, 4-5

Vol. XI—8

Vol. XIII—5, 6, 7, 9, 10

Vol. XIV—complete

Vol. XVII—complete

Vol. XVIII—complete

Vol. XIX—complete

Vol. XX—complete

Vol. XXI—complete

Vol. XXII—complete

Vol. XXIII—1, 2, 3, 4, 6, 7, 8, 9, 10

Vol. XXIV—complete

Vol. XXV—complete

Vol. XXVI—complete

Vol. XXVII—complete

Vol. XXXI—1, 2, 3, 4

Vols. XXXII to XXXIII—complete

Vol. XXXIV—2, 4

Vol. XXXV—complete

Vol. XXXVI—1, 2, 4, 6, 7, 8, 9, 10

Vol. XXXVII—1, 2, 4, 5, 6, 7, 8, 9, 10

Vol. XXXVIII—1, 2, 3, 4, 5, 6, 7, 8

Vol. XXXIX—1, 2, 5, 6, 7, 8, 9, 10

Vol. XL—complete

Vol. XLI—complete

Vol. XLII—complete

Back copies of Vols. I to XXVIII sell at 50 centavos a copy and back copies of Vols. XXXI to XXXIX sell at ₱1.50 a copy.

Send your order to the BUSINESS MANAGER, THE PHILIPPINE AGRICULTURIST, COLLEGE, LAGUNA, PHILIPPINES.